

ARTICLE



Conceptualizing a mobile-assisted learning environment featuring funds of knowledge for English learners' narrative writing development

Yan Chen, University of Nevada, Las Vegas

Hayley J. Mayall, Northern Illinois University

Thomas J. Smith, Northern Illinois University

Cindy S. York, Northern Illinois University

Abstract

The purpose of this exploratory sequential mixed-methods study is to investigate a group of middle-school aged Latinx English learners (ELs) in a rural town in the Midwestern United States and to facilitate their narrative writing development via a mobile-assisted language learning (MALL) environment from a funds of knowledge perspective. In particular, we first explored the existing funds of knowledge sources drawing from the ELs' lived experience and cultural practice through a multimethodological approach over a span of three months. We conceptualized the explored funds of knowledge sources into ELs' narrative writing practice through the integration of mobile-based writing tools (MBWTs). Second, we employed a multiple pre-and post- non-experimental design for the ELs to complete two non- funds of knowledge and three funds of knowledge-featured narrative writing activities over ten weeks using Google Docs as an MBWT. Results showed a statistically significant positive learning effect of funds of knowledge as an intervention for developing the ELs' literacy skills in narrative writing within a collaborative MALL environment.

Keywords: *Mobile assisted language learning, funds of knowledge, English learner, narrative writing*

Language(s) Learned in This Study: *English*

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Introduction

Mobile-assisted language learning (MALL) involves supporting the language teaching and learning process in varied formal and informal educational contexts using computing technologies such as short message services via mobile phones, microblogging via mobile 2.0 tools, ambient intelligence, augmented/virtual reality via mobile devices, and global positioning systems (Burston, 2013; Chwo et al., 2018; Kukulska-Hulme & Shield, 2008; Lin & Lin, 2019; Yang, 2013). The unique features of MALL environments consist of their “portability, social interactivity, context sensitivity, connectivity, individuality, and immediacy” (Lan et al., 2007, p. 131). The robust content knowledge support, collaboration and interaction affordances, associated pedagogical approaches, and affective design factors that MALL environments have achieved promote a new direction for collaborative MALL (Kukulska-Hulme & Shield, 2008; Kukulska-Hulme & Viberg, 2018). Among these studies, varied mobile-based writing tools (MBWTs), such as touch-based tablets and tablet apps, mobile phones, iPods, mobile-based concept maps, and web 2.0 tools, have been implemented to engage digital learners' complex and multilingual literacy development in writing (Chang & Lu, 2018; Cordero et al., 2015; Cordero et al., 2018; Cybart-Persenaire & Literat, 2018; Neumann, 2018). However, the design and implementation of effective MALL environments is a sophisticated process that

involves physical challenges (e.g., limited screen size) and pedagogical concerns (e.g., interactivity affordances) as well as psycho-social factors impeding the use of mobile devices for learning (Stockwell & Hubbard, 2013). Learners in MALL communities are diverse, and researchers have found that students' and teachers' expectations about using MALL do not always align (Cordero et al., 2018). Pedagogical applications in the majority of MALL studies are dominated by teacher-led approaches and lag behind contemporary learning theories and language acquisition principles (Burston, 2014; Kukulska-Hulme & Shield, 2008; Kukulska-Hulme & Viberg, 2018). Furthermore, incorporating sociocultural relevance in MALL is demanding (Jones et al., 2017). The lack of connections between designed learning tasks and learners' prior experiences of using personal mobile technology might cause distractions and interfere with learning effectiveness (Chwo et al., 2018).

Under these circumstances, researchers have advocated a funds of knowledge approach in developing rigorous MALL communities through mediating home-school communication, particularly for the rapidly increasing culturally and linguistically diverse student population of English Learners (ELs) in K–12 settings (Chen, 2020; 2021; Chen et al., 2017; 2019; Liu et al., 2014). Although a more complete description of funds of knowledge is provided subsequently, the concept of funds of knowledge briefly described is a framework that provides an inclusive pedagogical solution for ELs by acknowledging the students' cultural resources, knowledge, skills, and lived experiences gained from their households and communities (Moll et al., 1992). However, researchers have argued there might be discrepancies between the funds of knowledge sources perceived by teachers and the funds of knowledge sources that students have in reality, which may lead to the loss of certain instructional opportunities (Macias & Lalas, 2014). There is a lack of empirical studies that identify the emerging funds of knowledge sources as well as their learning effects for ELs who grow up in this digital generation (Llopart et al., 2018).

Therefore, the present study aims to achieve two distinct objectives using an exploratory sequential mixed-methods research design. First, we implemented a qualitative research phase to explore emerging funds of knowledge sources using a multimethodological approach over the span of three months. Then, we conceptualized the identified funds of knowledge sources into a mobile-assisted writing instructional framework and examined the learning effects, particularly of funds of knowledge as an intervention, on a group of middle-school aged Latinx ELs' narrative writing development using Google Docs as an MBWT. Narrative story writing was chosen as ELs' language development focus in the present study because writing has been identified as one of the most challenging tasks for ELs, as evidenced by much lower scores on national writing assessments compared to their non-EL peers (Janzen, 2008; Maxwell, 2012). Among varied writing genres, researchers also considered narrative as the most suitable and inspirational genre, as its structure has the capacity to build connections between cultural knowledge and social experiences (Gutiérrez et al., 2015). Mobile-based Google Docs via the school-district-issued 1:1 devices of Chromebooks was adopted as the MBWT because Google Docs has shown effective pedagogical benefits for facilitating student writing engagement and performance in various settings (Koubek & Bedward, 2015; Zheng et al., 2015).

Literature Review

Examining Current Applications of Mobile-based Writing Tools

In supporting young learners' writing and communication development, current MALL studies have employed varied MBWTs such as touch-based tablets and tablet apps, mobile phones, iPods, mobile-based concept maps, and web 2.0 tools (Chang & Lu, 2018; Cordero et al., 2015; Cordero et al., 2018; Cybart-Persenaire & Literat, 2018; Neumann, 2018). For instance, Neumann (2018) employed iPad Air 2 and iPad apps (e.g., Endless Alphabet and Letter School) to assist children aged 2–5 in developing their emergent literacy skills such as print concepts, name writing, letter writing, letter name and sound knowledge, and numeral name knowledge. The touch-based iPad and apps provided multisensory and engaging ways to enhance students' motivation and learning effects. Cybart-Persenaire and Literat (2018) utilized personal cell phones to facilitate a group of marginalized high school students aged 14–18 in writing newspapers. In

particular, the students used their cell phones to take photos, record interviews, keep notes, look up vocabulary and statistics information, and retrieve the sources of information at home, in the community, and at school. Cybart-Persenaire and Literat posited that the mobility of using personal cell phones as writing tools evidenced that the students transformed their identity across varied familiar “physical and conceptual spaces” such as self, home, school, peer relationships, and local community (p. 188). Similarly, Kirsch and Izuel (2019) indicated that these hybrid learning spaces afforded through MALL provided students more control over learning tasks and enabled them to interact with each other, engage in metalinguistic communication for knowledge construction, and create more flexible and safer spaces for learning.

Recent studies have incorporated increasingly commonly-used Google classroom applications as MBWTs because they are effective in facilitating student writing engagement in various settings (Chen, 2020; 2021; Chen et al., 2020; Chinnery, 2008; Domingo & Garganté, 2016; Zheng et al., 2015). Chinnery (2008) highlighted that Google applications function as informative, productive, collaborative, communicative, and aggregative tools. The information offered through the Internet also enables learners to use Google applications as a corpus tool for language learning (Domingo & Garganté, 2016). As an MBWT, Google Docs, functioning as a web-based word processor, offers a collaborative writing platform due to the simplicity of its writing interface and its relationship with other commonly used Google tools (Lin & Yang, 2013; Zheng et al., 2015). Embedded in mobile devices such as Google Chromebooks and tablets, mobilized Google Docs extends the horizon of MALL environments by connecting the learners’ formal classroom learning with informal contexts (Chen, 2020; 2021; Chen et al., 2017; 2020).

Incorporating Funds of Knowledge into Mobile-based Writing Practice

The concept of funds of knowledge refers to “historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being” (Moll et al., 1992, p. 133). It provides cultural scaffolding for teaching diverse ethnic-minority students “using their cultures and experiences to expand their intellectual horizons and academic achievement” (Gay, 2002, p. 109) to heighten culturally sensitive care and to build a culturally responsive learning community. In particular, the integration of funds of knowledge into language and literacy curricula promotes new learning between home and school and encourages the students’ imagination and creativity in developing home-type discourse in school-based learning spaces (Cook, 2005; Moll, 1992; Upadhyay, 2006; Wei, 2014). The dialogical relationship formed through a funds of knowledge lens leverages the power asymmetries distributed among teachers, students, and their family and communities (González et al., 2005; Rodriguez, 2013). It also enables students to bridge, navigate, and transform their academic learning and discourses beyond the boundaries of school contexts (Assaf, 2014; Esteban-Guitart, 2016; Fitts, 2009; Grant, 2011).

The abundance of knowledge and the opportunity for social interactions available through funds of knowledge can be conceptualized for teaching through developing meaning-based literacy instruction, collaborating with teachers and students’ families and communities, and mobilizing those household resources for instructional innovation (Moll, 1992). For instance, Chen et al. (2017) engaged ELs (aged 9–13) from Mexican-American and Asian-American families in narrating their lawn-mowing or travel experiences using tablets and the Penultimate writing app. Chen et al. (2020) applied Google Earth Virtual Reality apps via school-issued Chromebooks and encouraged middle-school aged Latinx ELs to document their virtual travel experiences to Mexico or in the United States through funds-of-knowledge-featured writing topics such as *describing your favorite city or hometown*. Findings of these preliminary studies showed that the funds of knowledge sources can “serve as a vast treasure trove of writing possibilities for writers of all ages – and of all backgrounds” (Newman, 2012, p. 25). Incorporating relevant funds using MBWTs in writing supported ELs’ learning motivation and engaged the EL in “[forging] connections between seemingly disparate bits of knowledge and experience” for meaning-making (Byler & Perkins, 1999, p. 245). Findings also showed that the ELs’ technology-based funds of knowledge, such as their physical access to mobile tools and digital skills, provide relevant connections for more approachable curriculum design (Chen et al., 2019). However, research has pointed out that it has been challenging to

delineate the sources of the students' funds of knowledge, considering the sources of knowledge and skills, the individuals who provide the knowledge, and the validity of these sources (Hogg, 2011).

Research Questions

In reflecting on recurring gaps within the literature, the present study employed an exploratory sequential mixed-methods research design and addressed two research questions:

1. What funds of knowledge sources exist in grades 6–8 in Latinx ELs' households?
2. To what extent do narrative writing skills of Latinx ELs in grades 6–8 grow as they progress from non-funds-of-knowledge- to funds-of-knowledge-featured topics using Google Docs as an MBWT?

Methodology

Research Sites

Using a convenience sampling method, we chose two research sites: a Latinx community and a nearby middle school in a rural town in the Midwestern United States. This town had a population of 5,193. Individuals of [Hispanic/Latinx](#) race constituted 10.65% of the population. During the research year, middle school enrollment was 436, which was 24.6% of the total enrollment of the school district (Illinois Report Card, 2017). The students' race/ethnicity was 82.1% White, 15.8% Hispanic, 1.1% Black, 0.7% Asian, and 0.2% indicated two or more races. Among the students, 2.8% of the students were ELs and were eligible for bilingual education, and 41.3% were from low-income families. The chosen school district focused on incorporating technology as an integral part of the students' education, and students above the third grade were required to use a school-issued one-to-one Google Chromebook to support their learning.

Participants

EL Teacher

The EL teacher was a Caucasian female in her early 30s. She had an undergraduate degree in Spanish Translation, a master's degree in Spanish Language and ESL, as well as a Master of Arts in Teaching. She had been teaching ELs in the chosen school district for over 10 years. To implement the funds of knowledge approach, the EL teacher was involved in the present study as a teacher-researcher, a Spanish-English translator, and a grader for the ELs' writing artifacts.

EL Parents

During the first qualitative research phase, six Latinx families (11 parents, aged 31–45) were involved in the home-visits based on their willingness (see [Table 1](#)). Seven ELs from the families were present during the home-visits as well. The sample size of the participating families was finalized when the point of saturation was reached (Denzin & Lincoln, 2018).

Table 1*Demographic Characteristics of the Home Visited Parents*

Parents' age	Parents' place of birth	Years lived in the US	Marital status	Number of children	Highest level of education
36–40	Mexico	21–25	Married	3	High school
36–40	Mexico	21–25	Married	3	High school
41–45	Mexico	16–20	Married	4	Middle School
36–40	Mexico	16–20	Married	4	Elementary school
36–40	Mexico	11–15	Married	3	High school
36–40	Mexico	11–15	Married	3	High school
41–45	Mexico	26–30	Married	3	Middle school
41–45	Mexico	26–30	Married	3	Middle school
31–35	Mexico	11–15	Married	3	Elementary school
26–30	Mexico	11–15	Married	3	Middle school
31–35	United States	31–35	Single	5	Middle School

EL Students

During the second quantitative research phase, 18 ELs (aged 12–15) at the middle school from Latinx families participated in the study (including the seven ELs from the home-visited families). Grade levels were combined and included four sixth graders (four boys), seven seventh graders (six boys and one girl), and seven eighth graders (five boys and two girls). The mean number of years they had spent in the US was 11.38 years ($SD = 3.85$). The majority of the participating ELs were born into Mexican-American families and were English-Spanish speakers. In addition, we selected the ELs based on the WIDA-ACCESS Placement Test. The mean of the ELs' reading proficiency level was 3.06 ($SD = 0.81$), with a range of 1.9–4.4. The mean of the ELs' writing proficiency level was 3.38 ($SD = 0.55$), with a range of 1.9–4.1. The composite (overall) proficiency level was 3.65 ($SD = 0.64$), with a range of 2.5–4.7. These data indicated their eligibility for the ESL program as well as their learning needs in reading and writing skills in English. Among the participating ELs, only one 6th grader's reading proficiency level was scored higher (4.4) than the required proficiency level (4.2), but this student did not meet the reading proficiency and the composite writing proficiency (Illinois State Board of Education, 2015).

Data Collection and Analysis Techniques**Qualitative Research Phase**

During the qualitative research phase, we took a multimethodological approach to complement the limitations of traditional funds of knowledge research methods, such as home visits and adult interviews, and to enhance the trustworthiness of data collection (Esteban-Guitart, 2016). First, each family was visited at home by the lead researcher and EL teacher who served as an English-Spanish translator because the parents did not speak fluent English. These queries focused on each family's immigration history, parents' education and working experience, household literacy practices and technology use, individual interests, and family's social/cooperative practices in their community. Second, the seven home-visited ELs were asked to color a simple picture called the language silhouette to indicate their use of more than one language (Martin, 2012) and to complete a three-question descriptive survey to help the researchers triangulate the identification of their funds of knowledge, including *How would you rate your skills using computers? How much do you use your computer at school?* and *How much do you use your computer at home?* (adapted from Zheng et al., 2015). Third, in the company of the EL teacher, the lead researcher participated in community events and activities such as weddings, communion services, and children's birthday celebrations. The lead researcher kept field notes and analytical memos throughout the fieldwork.

To help with the analysis of collected data, interviews were transcribed verbatim to English by a university

Spanish professor and a student majoring in Spanish at the leader researcher's

university. The data analysis was completed using NVivo 10 software through three coding cycles: (a) *descriptive coding* to generate a detailed inventory of funds of knowledge sources, (b) *pattern coding* for grouping initial codes into focused themes and constructs, and (c) *post-coding* to map interdependencies among these themes and constructs (Saldaña, 2015). To establish the trustworthiness of the qualitative research phase and shape the coding results into a coherent and trustworthy story, the lead researcher, who was experienced in qualitative studies focusing on ELs, documented field notes and analytical memos. Member-checking in the present study was achieved through the research collaborators who are experienced educational researchers (Denzin & Lincoln, 2018).

Quantitative Research Phase

During the quantitative research period, we embedded the identified funds of knowledge sources into a mobile-assisted funds-of-knowledge-featured writing instructional framework as the instructional context that the lead researcher iteratively developed based on fieldwork with the Latinx community and classroom involvement with the EL students (adapted from Chen, 2020; 2021; Chen et al., 2017). Via this instructional framework, the ELs completed five narrative writing projects using a multiple pre-and post-essay non-experimental design. These writing topics included two non-funds-of-knowledge topics (*an unexpected event* and *the best day at school*) that were suggested by the EL teacher as well as three funds-of-knowledge-topics (*my family story*, *my travel story*, and *my game story*) that were drawn from the qualitative research phase. The ELs spent 30 minutes on the writing projects on Tuesday, Wednesday, and Friday mornings over a period of ten weeks. For each topic, the ELs were required to complete a pre-essay using pen-and-paper and a post-essay using Google Docs as an MBWT.

In total, 180 essays (both pre- and post-essays) were collected. The writing artifacts were separately graded by the EL teacher and lead researcher (trained by the EL teacher) using the adapted IMAGE Writing Summary Rubric from the Language Proficiency Handbook (Gottlieb, 1999), which is a focused-analytic matrix based on five dimensions using a 6-point scale to reflect the students' second language acquisition process. The five dimensions include *language production* to measure the degrees of second language acquisition process in writing; *focus* to measure the clarity of the main idea; *support/elaboration* to measure the specific evidence and detailed reasons that elaborate the main idea; *organization* to measure the logical flow of the writing text; and *mechanics* to measure the application of conventions of Standard English such as spelling and punctuation. An inter-rater reliability analysis using Kappa statistics was conducted to determine consistency between the two graders, indicating a good level of inter-rater reliability agreement with a range of 0.81 ~ 1.00. We used paired samples *t*-tests, within-subjects repeated measures ANOVA, and custom contrast to address the learning effects of using funds of knowledge as a writing intervention.

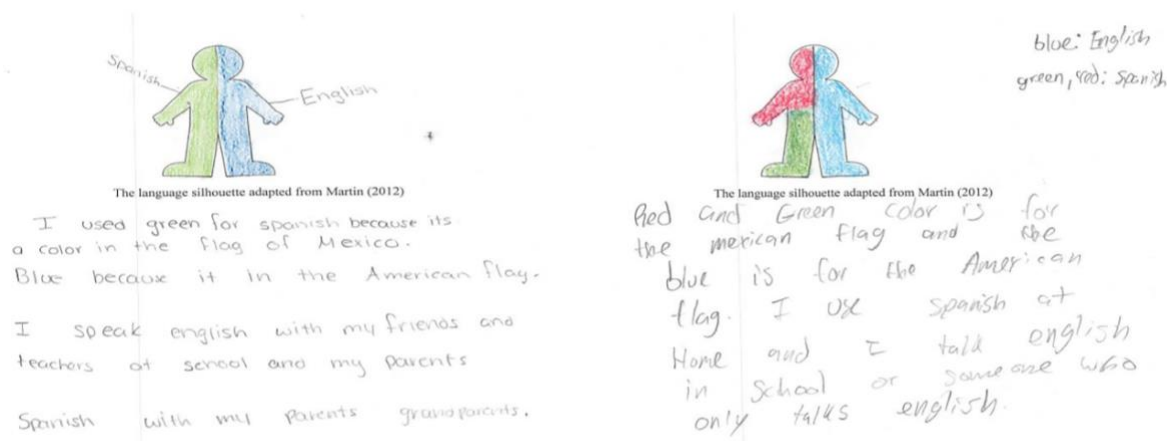
Findings

Identified Funds of Knowledge Sources in ELs Households

Regarding the first research question, we found that the ELs had clear language self-awareness and cultural/identity assuredness based on their language silhouette activities (see Figure 1). Results of the three-question survey showed that all the home-visited ELs believed they were beginner (11%), intermediate (44%), advanced (28%), or expert (17%) computer users. The percentages of ELs' daily computer use at school were less than 1h a day (17%), 1–2h a day (17%), 2–3h a day (17%), 3–4h a day (22%), 4–5h a day (11%), and 5–6h a day (17%). The percentages of ELs' daily computer use at home were less than 1h a day (6%), 1–2h a day (39%), 2–3h a day (22%), 3–4h a day (17%), 4–5h a day (6%), and 5–6h a day (11%).

Figure 1

Samples of ELs' language silhouette



These preliminary findings helped us validate the feasibility of integrating emerging mobile technology into the students' narrative writing practices. We triangulated these findings with collected data sources from home visits and community participant observations and identified codes to depict the cultural system based on collected qualitative data. We categorized the identified funds of knowledge sources into (a) family-based, (b) center-based, (c) community-based, and (d) technology-based (Chen, 2020; 2021; Chen et al., 2017; Hedges et al., 2011).

Family-based Funds of Knowledge

The family-based funds of knowledge category (Hedges et al., 2011), which emphasizes the connections with family members, was drawn from data on the ELs' families' immigration histories, religions, and traditions that shaped their living environments. These families lived on farmland or in a trailer park. The majority of the parents had grown up in poor villages in Mexico and did not go to college. Since immigrating to the United States, they worked in environments/settings that did not demand a high level of English proficiency or special skills, such as construction, maintenance, in factories, or on farms. These families predominantly were Catholic and kept the traditions of celebrating family members' birthdays and holidays such as Christmas and Thanksgiving. The ELs learned landscaping, mechanical work, and shooting from their parents. The ELs engaged in Bible studies and learned how to cook and do chores at home. Their parents taught them to have good manners and told them about their own childhoods in Mexico during family story times. These stories included parents' struggles with poverty and working on the ranch as well as fun activities such as playing marbles. For example:

My husband really likes to garden. Here is the area that he has out back here, he goes out to work it, to plant lettuce and tomatoes. He takes the kids to help him. Their job is to water the garden as the plants are growing. And he has already done it for three years. We have gotten a lot of vegetables in the backyard. (Interview with EL parent)

Center-based Funds of Knowledge

The center-based funds of knowledge category (Hedges et al., 2011), which emphasizes pedagogical relationships with family members or peers, was drawn from data on the literacy and language-learning centered resources at home. Families had few or no literacy resources at home, and the ELs seldom studied after school. Parents had little or no reading time for their children because most of them were busy with work. For example:

We can't do that [reading time] because my husband is sometimes with the baby and I'm working,

so then he [my husband] has to take care of her [the baby] so that they [the older children] can work on their homework. (Interview with EL parent)

Parents did not show a clear expectation for their children's futures and believed their children received sufficient education from the schools. The language used in the families was mainly Spanish. The parents expected their children to be bilingual and hoped they would value their Mexican cultural identity. They believed that their children "get to speak English at school." To learn Spanish would be helpful for the ELs to better communicate with other family members. Sometimes the ELs spoke in English with their parents because the parents wanted to learn English.

Community-based Funds of Knowledge

The community-based funds of knowledge category (Hedges et al., 2011), which emphasizes sociocultural settings, was drawn from data on the ELs' activities or interactions within their culture-related communities, especially in the presence of their parents. The families enjoyed cooking, shopping, and going to church, the cinema, and the park during their limited free time. Sometimes parents took the children to the library "because there are computers in the library." The children could use the computers instead of reading books. The ELs and their families also valued cultural events within their communities. The families celebrated American cultural events in Mexican ways at home or in the community and celebrated traditional Mexican festivals such as *Cinco de Mayo*. As a routine, many families traveled to Mexico to visit relatives for three or four weeks in December every year, especially for first-generation immigrant families. They traveled by bus or drove their own trucks because they could not afford plane tickets. While staying in Mexico, the ELs rode tractors, trucks, or motorcycles in town, even though they were under 13. They enjoyed riding horses and feeding cows on the ranch. The families liked bringing candy, cheese, and chicharrón back to the US after their vacation. They shopped for clothes, necklaces, or bracelets because of the cultural design and Spanish words on these souvenirs. They celebrated Christmas with their families. For example:

For Christmas, all my family gets together. We have a big feast, we eat pozole tacos de asada arroz. Before we eat, we pray. We also celebrate el niño Dios; we put candy all around el niño Dios, and you kiss it to get candy. After we are done, we sing "camino de belén." After that, we eat all our food. Later in the night, we drink ponche and hand out los aguinaldos, inside los aguinaldos, they put candy and animal crackers. (Interview with ELs)

Technology-based Funds of Knowledge

The technology-based funds of knowledge category (Chen et al., 2017; 2019), which emphasizes technology access and skills, was drawn from data on specific activities or interactions related to technology in which ELs were involved at home and in the community. The parents perceived and experienced the rapidly developing technological world around them and supervised their children's use of technology. Even though some parents did not have a clear idea about how to use the technology they had, they spent money on mobile phones, tablets, and iPods for their children. The ELs enjoyed using these mobile devices for entertainment and learning at home. Some ELs brought their Google Chromebooks home from school to continue working on homework. Parents valued the mobility and engagement that these devices brought to their children's education. However, a lack of adequate educational skills limited the parents' involvement with their children's use of technology. For example:

Well it's helpful because they know how to speak English very well. But, for example, a word that they don't know. All they need to do is look it up [online]. This is the word thing what they have used the most. It's really handy for looking up words that they didn't know. (Interview with EL parents)

Contextualizing Funds of Knowledge Resources in a Mobile-assisted Instructional Framework

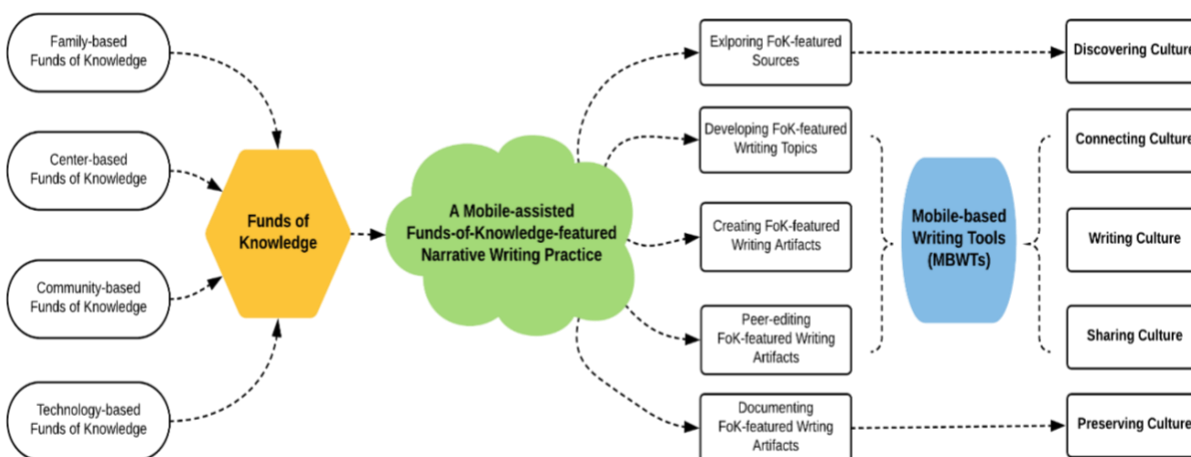
Based on the identified funds of knowledge categories, we considered *conceptualization* as "the connection between the school and the lives of the students" (Esteban-Guitart, 2016, p. 31). In collaboration with the

EL teacher, we implemented a mobile-assisted writing instructional framework to incorporate the identified four funds of knowledge categories to scaffold classroom writing practice through five steps: *discovering*, *connecting*, *writing*, *sharing*, and *preserving* culture (see Figure 2, adapted from Chen, 2020; 2021; Chen et al., 2017). These incorporated funds of knowledge sources addressed the ELs' lived experiences in their households and communities through their parents' and the ELs' perspectives in order to support their learning identity growth (Esteban-Guitart, 2016).

To complete each writing task, the ELs were encouraged to interact with their families to *discover* the main sources of their household stories and take pictures from home using the cameras built into their Chromebooks; to *connect* their ideas with classroom practice to develop their writing topics; to *write* their stories using Google Docs; to *share* their stories with EL teachers, classmates, and parents using Google Docs for peer-editing; and to *preserve* their culture by documenting and revisiting their writing artifacts in Google Drive. In addition, we chose Google Docs via Chromebook as an MBWT because it is derived from the ELs' technology-based funds of knowledge, which further reinforced the collaborations among teachers, ELs, their families, and peers from their classrooms or communities.

Figure 2

A Mobile-assisted Funds-of-knowledge-featured Instructional Framework



Learning Effects of Funds-of-Knowledge-featured Topics as Writing Intervention

Regarding the second research question, we considered the use of Google Docs as an MBWT as a controlled variable. We asked the students to complete two non-funds-of-knowledge and three funds-of-knowledge narrative essays via the mobile-assisted funds-of-knowledge-featured instructional framework. The 180 collected pre- and post- essays were graded and analyzed.

Results of Paired Samples *t*-Tests Analysis

Table 2 shows descriptive statistics for the ELs' overall scores on each of the five writing topics. Paired samples *t*-tests comparing pre-essay scores using pen-and-paper compared to post-essay scores with a Chromebook showed statistically significant differences for each of the five writing topics ($p < .001$). The effect size for each mean difference in scores was large (Cohen's $d > 0.80$). These results indicated that students' scores increased from the pre-essay to the post-essay on each of the five repeated writing tasks.

Table 2*Results of Paired Samples T-Tests*

Topics	<i>M</i> (pre-)	<i>M</i> (post-)	<i>M</i> (gain score)	<i>SD</i>	<i>t</i>	Cohen's <i>d</i>
An unexpected event	17.00	18.67	1.67	1.75	4.04***	0.95
The best day at school	18.28	21.61	3.33	1.82	7.79***	1.84
My family story	17.06	21.78	4.72	1.90	10.52***	2.48
My travel story	20.67	24.06	3.39	2.12	6.79***	1.60
My game story	19.89	23.78	3.89	1.78	9.28***	2.19

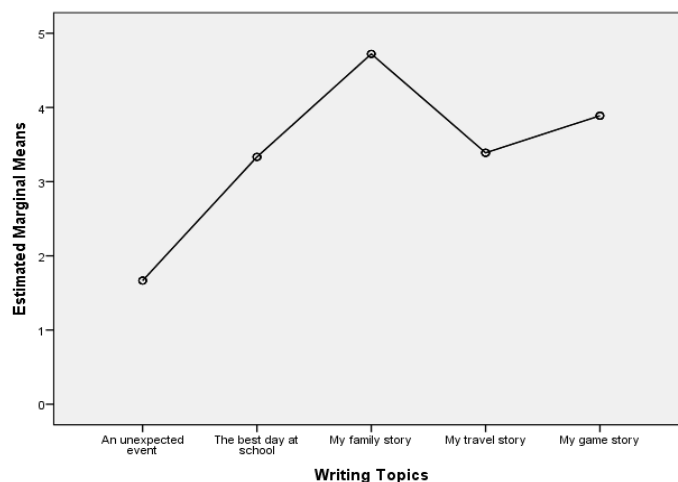
Notes. * $p < .05$. ** $p < .01$. *** $p < .001$.

Results of Repeated-Measures ANOVA

A repeated-measures ANOVA was carried out to assess how the ELs' gain scores (post-essay score minus pre-essay score) varied across the five narrative writing topics. Results of the (sphericity-assumed) repeated measures ANOVA showed a statistically significant change in gain scores of ELs' narrative writing across the five topics [$F(4, 68) = 8.53, p < .001$]. The effect size was large with $\eta^2 = 0.33$. Figure 3 shows the change of gain scores across writing topics.

Figure 3

Estimated Marginal Means of ELs' Gain Scores across Five Narrative Writing Topics



Results of Bonferroni Post Hoc Analysis

In view of the statistically significant results, a Bonferroni post hoc analysis was performed to compare the mean gain scores for all pairs of writing topics to determine where mean differences occurred. Table 3 provides a comparison of mean scores for all paired combinations of the five levels of the repeated factor. Results showed statistically significant pairwise differences between *an unexpected event* and *the best day at school*, $M_{diff} = 1.67, SD = 0.32, p < .01$); *an unexpected event* and *my family story*, $M_{diff} = 3.06, SD = 0.50, p < .001$); and *an unexpected event* and *my game story*, $M_{diff} = 2.22, SD = 0.47, p < .01$). There was no statistically significant difference in gain scores between *the best day at school* and the three funds-of-knowledge-featured topics.

Table 3*Summary Table of Bonferroni Post Hoc Analysis*

Topics	An unexpected event	The best day at school	My family story	My travel story	My game story
An unexpected event	--	1.67**	3.06 ***	1.72	2.22**
The best day at school	-1.67**	--	1.39	0.06	0.56
My family story	-3.06***	-1.39	--	-1.33	-0.83
My travel story	-1.72	-0.06	1.33	--	0.50
My game story	-2.22**	.056	0.83	-0.50	--

Notes. * $p < .05$. ** $p < .01$. *** $p < .001$.

Results of Custom Contrast Analysis

A custom contrast was performed to further examine differences in gain scores (post-essay score minus pre-essay score) between non-funds-of-knowledge and funds-of-knowledge writing topics for each of the five writing practices. The results showed statistical significance between the two non-funds-of-knowledge and the three funds-of-knowledge writing topics [$F(1, 17) = 14.79$, $p < .001$; see Table 4], with mean gain scores on the funds-of-knowledge writing topics greater than mean gain scores on the non-funds-of-knowledge writing topics.

Table 4

Custom Contrast Test Comparing Gain Scores from Non-funds-of-knowledge to Funds-of-knowledge Writing Topics

Source	Sum of Squares	df	Mean Square	F
Contrast	40.28	1	40.28	14.79***
Error	46.31	17	2.72	

Notes. * $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

Using an exploratory sequential mixed-methods research design, the present study encouraged middle school-aged Latinx ELs in MALL communities to develop their narrative writing competency from a funds of knowledge approach. This approach addressed the significance of developing and implementing a collaborative MALL environment to embed sociocultural factors from informal contexts in formal classroom practices (Kukulska-Hulme & Viberg, 2018). It also provided methodological diversity to the interdisciplinary fields of MALL and second language acquisition by validating the learning effects of using funds of knowledge as an intervention in developing culturally and linguistically diverse ELs' narrative writing competencies using emerging Google Classroom applications (Ok & Ratliffe, 2018).

During the qualitative research phase, we adopted a multimethodological approach and delineated the funds of knowledge sources within and between the ELs' households and culture-related communities, both in the United States and Mexico, and underscored the ELs' ordinary experiences, both in their parents' presence and their own voices (Esteban-Guitart, 2016). Findings revealed abundant funds of knowledge sources in four categories: family-based, center-based, community-based, and technology-based. These funds of knowledge sources allowed the ELs to bring in relevant aspects from their household cultural

practices and ordinary routines into the mobile-assisted writing spaces. These findings concur with previous studies that funds of knowledge not only opens a window full of writing possibilities for language learners with varied backgrounds, but also supports ELs in developing their identities as writers (Chen, 2021; Chen et al., 2017; 2019; Dworin, 2006; Haneda & Wells, 2012; Newman, 2012). Additionally, technology-based funds of knowledge were clearly observed and documented in ELs' households, which indicated that mobile technology had become an inseparable part of the students' lived experiences, including for those from economically marginalized families. The ELs' acceptance, experiences, knowledge, and skills of using mobile technology and their parents' positive perceptions confirmed the implementation of MALL as a potential and powerful method that influences their learning engagement (Chen, 2021; Chen et al., 2017; 2019; Hogg, 2011; Esteban-Guitart, 2016; Neumann, 2018).

To empower funds of knowledge as an effective pedagogical solution, we implemented a mobile-assisted funds-of-knowledge-featured instructional framework that created an inclusive, collaborative MALL environment. Through the lens of funds of knowledge, EL parents, teachers, and peers are resources who provide cultural, social, and language tools for the students' writing development (Vygotsky, 1978). These technology-enhanced collaborations using MBWTs promoted interactions among teachers, ELs, and the ELs' families, and strengthened home-school relationships (Chwo et al., 2018; Grant, 2011). The funds of knowledge sources identified were conceptualized into the ELs' classroom writing activities for them to narrate in their own voices. These writing topics functioned like a cube with its multiple facets, allowing the students to create their own stories seen from different sides (Newman, 2012). Drawing on the ELs' technology-based funds of knowledge, the embedded Google Docs as MBWTs functioned as a vehicle both to innovate meaning-based literacy instruction in a communication-based writing curriculum and to reposition and engage ELs in learning through multimodal approaches. It also enabled the teacher to understand the functionality of this MALL system to help ELs maintain a higher level of access and engagement (Chinnery, 2008; Chwo et al., 2018; Liu et al., 2014).

Considering Google Docs as MBWT as a controlled variable, results from the quantitative research phase showed statistically positive effects of using funds of knowledge in ELs' narrative writing gain scores across five repeated practices. Statistically, pairwise differences were found between non-funds-of-knowledge and funds-of-knowledge topics, with greater growth in the funds of knowledge essays. More specifically, there was a significant difference between the writing topics of *an unexpected event* and *the best day at school, my family story, and my game story*; there were non-significant differences between *the best day at school* and the three funds of knowledge topics; and there were non-significant differences among the three funds of knowledge topics. Compared to *an unexpected day*, the topic of *the best day at school* seemed easier for the students because some ELs noted that "my teacher asked me to write about it before." This could explain the non-significant differences between *the best day at school* and each of the three funds of knowledge writing topics. However, a few ELs expressed sadness about the topic of *my travel story* because they had not had many travel experiences. As a result, the EL teacher helped them recall their *mini-travel* experiences about visiting shopping malls or other nearby towns with their families. These challenges could explain why the students' performances on the topic of *my travel story* showed slightly less growth than their performances on the other funds-of-knowledge topics, although there were no significant differences among the funds-of-knowledge topics. These findings corroborated the value of pedagogical hybrid spaces supported through MALL in developing culturally responsive teaching practices by linking the intersections of diverse learners' second language acquisition and technology integration in students' lived sociocultural experiences (Labbo & Place, 2010; Liu et al., 2014; Ok & Ratliffe, 2018).

Limitations and Future Studies

Two limitations are noted. First, the numbers of participating ELs' families and EL students were limited because of recruitment challenges. However, the multimethodological approach employed in the qualitative research phase allowed triangulation, which achieved thickness of the collected data and mitigated concerns about generalizability. The within-subject repeated measures design employed in the quantitative research

phase enhanced statistical power, evaluated growth rather than achievement at a single point in time, and ameliorated the effect of subject homogeneity. Second, we viewed the ELs' narrative writing products as cultural artifacts; we did not emphasize the learning effects on each writing dimension through a linguistic perspective.

Future studies could employ a linguistic framework to examine the learning effects of the use of different MBWTs on writing development with a larger sample of Latinx ELs. Future studies could also focus on investigating the intricate hybrid nature of funds of knowledge and establishing a potent theoretical rationale for the mobile-assisted funds-of-knowledge-featured learning environment that the present study has developed.

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About the Authors

Yan Chen is Assistant Professor in the Department of Teaching and Learning at the University of Nevada, Las Vegas. Her research interests focus on how people learn through social interaction when situated in hybrid, technology-based learning spaces. She is interested in how sociocultural and historical settings shape these interactions and how to design new cultural practices for equitable digital learning.

E-mail: yan.chen@unlv.edu

Hayley J. Mayall is Associate Professor in the Department of Educational Technology, Research and Assessment at Northern Illinois University. Her research interests focus on instructional design, technology for pre-service teachers, and educational software development.

E-mail: hmayall@niu.edu

Thomas J. Smith is Professor in the Department of Educational Research and Evaluation at Northern Illinois University. His research interests focus on quantitative research methodology and large-scale data analysis.

E-mail: tjsmith@niu.edu

Cindy S. York is Associate Professor in the Department of Educational Technology, Research and Assessment at Northern Illinois University. Her research interests focus on expert/novice research, online learning and teaching, instructional design, technology integration, artificial intelligence in education, and teacher education.

E-mail: cindy.york@niu.edu