Exploring the Affordances and Effectiveness of a Digital Game in the Chinese Dual Language Immersion Classroom (探索电子游戏在中文沉浸式课堂中的可用功能和有效性)

Poole, Frederick
Michigan State University
(密西根州立大学)
poolefre@msu.edu

Clarke-Midura, Jody
Utah State University
(犹他州立大学)
Jody.clarke@msu.edu

Ji, Siyu
(纪斯雨)
Utah State University
(犹他州立大学)
A02315460@aggies.usu.edu

Abstract: Recent studies have found that Chinese dual language immersion learners tend to lag behind their peers studying other languages in terms of literacy skills. Yet, teachers cannot simply prioritize literacy skills at the detriment of oral communicative skills. The present study explores how the integration of a digital game into the dual language immersion classroom affords opportunities for meaningful language use while also supporting learners' vocabulary and reading development. In this study two sixth-grade Chinese dual language immersion classes play a digital game in eight sessions across four weeks. Audio data of students interacting with the researcher were recorded and seven affordances that emerged through in-class gameplay were identified. Further, results indicate that after 4 weeks of gameplay, students had significant vocabulary and reading comprehension gains and their reading gains were significantly associated with completion of a workbook supplemental to the game.

摘要：最近一些研究发现中文沉浸式的学习者在读写能力方面落后于其他语言的学习者。教师不能简单地优先教授读写技能而不利于口语技能。此研究探索一个电子游戏在中文沉浸式课堂中如何在提高学习者词汇量和阅读能力的同时提供有意义地运用语言的机会。两个六年级的中文沉浸式班级在为期四周的研究中玩了八次同一个电子游戏。我们对学习者玩游戏过程中与研究者的互动进行了录音并编码音频数据，发现课堂游戏过程中出现的七个可用功能。而且，研究结果表示学习者在四周的游戏以后在词汇量和阅读理解方面有显著进步。他们的阅读进步与游戏的补充工作本的完成明显相关。

Keywords: Game-based language teaching; Dual language immersion; Chinese as a foreign language

关键词: 以游戏为中心的语言教学;双语沉浸式;对外汉语教学

1. Introduction

Two recent studies investigating student proficiencies according to the American Council on Teaching Foreign Languages (ACTFL) Scale (ACTFL, 2012) found that while students in Chinese dual language immersion (DLI) programs reported proficiency gains at each grade level, they tended to lag behind their peers who were learning other languages in similar programs (Burkhauser et al., 2016; Watzinger-Tharp et al., 2018). Specifically, Burkhauser et al. (2016) found that Chinese students on average received a Novice High skill in reading compared to learners studying Spanish and Japanese who achieved an Intermediate Low or higher on reading. Similarly, Watzinger-Tharp et al. (2018) found that students learning Chinese in the Utah DLI program received lower scores on reading and speaking assessments on average compared to French and Spanish students. Authors in both studies suggest that this may be due to the difficulties associated with learning the nonalphabetic script of Chinese.

Improving reading skills for students learning Chinese as a foreign language involves not only developing learner character knowledge (Shen, 2013), but also providing students with opportunities to read Chinese words in context (Shen, et al. 2020). This presents a challenge to many Chinese DLI teachers who must strike a balance between developing character recognition skills, vocabulary knowledge, reading comprehension skills, and communicative competencies in an already tight academic schedule (Poole, et al. 2019). As illustrated in several studies (e.g., Allen, 2008; Poole & Sung, 2015), there is concern that spending too much time on teaching characters and or vocabulary can hinder students' oral skills yet ignoring vocabulary instruction can severely impact students' literacy skills.

Integrating digital games into instruction may provide a solution to this challenge. Researchers investigating digital games for foreign/second language learning have argued that games can promote vocabulary learning (e.g., Ansteeg, 2015; Yudintseva, 2015), provide opportunities for meaningful interactions (Dalton & Devitt, 2016; Peterson, 2011), and provide an enjoyable environment for learners (Gee, 2007). In other words, digital games may provide an environment that promotes vocabulary knowledge and literacy skills while also allowing learners to develop their oral/communicative skills. Yet, studies using games to support learning Chinese as a foreign language have primarily investigated how games can be used to promote vocabulary learning (e.g. McGraw et al. 2009). Further, such studies are typically conducted outside of the classroom thus limiting the opportunity for teacher intervention and/or interaction with other peers while playing the game. In addition, given the focus of these studies on vocabulary development, it is unclear how the use of such games impact other proficiencies. This is similar to the digital game-based language learning (DGBLL) field as a whole, which has largely focused on digital games in second language (L2) learning as a challenge in design rather than as a classroom tool (York et al. 2021).

Recently, there has been a call to further explore how games can be integrated into the L2 classroom (e.g., deHaan, 2019; York, 2020). By integrating games into the classroom, teachers can design activities around the game, provide opportunities for

interaction, and support learners as they play the game (York, et al., 2021). This mediation provided by instructors may be even more important when considering the younger learners in DLI programs. To better understand how digital games can impact learning in DLI classrooms more research is needed. To address these needs, the present study explores the effectiveness of a digital game with support via supplementary material and teacher mediation as a means to promote Chinese vocabulary learning and reading comprehension in an elementary DLI classroom. We use an ecological framework (van Lier, 2004) in order to explore how integrating games into the L2 classroom affords additional opportunities for learning.

2. Literature Review

Early research on digital games used in L2 learning contexts focused on the potential learning benefits, challenges, and opportunities of games for L2 learning (e.g. Baltra, 1990; Hubbard, 1991). Recently, L2 studies involving digital games have investigated a wider range of areas including student perspectives (e.g. De Gove, et al, 2013), change in affect (e.g. Lim, 2008), vocabulary development (e.g. Cobb & Horst, 2011), and other more specific L2 proficiencies including listening, speaking, reading, and grammar. In this literature review we will first focus specifically on game designs and studies that have targeted vocabulary and readings skills. Next, we will discuss how an ecological framework impacts the way we evaluate and view games in a language learning context.

2.1 Vocabulary Learning with Digital Games

Studies exploring vocabulary learning via digital games tend to explore the impact of games that leverage a drill-and-kill game mechanic (Egenfeldt-Nielsen, 2007) in which students are asked to either translate vocabulary words or provide the correct answers to a problem multiple times (often at high speeds) and are subsequently awarded points for correct answers. Cobb and Horst (2011) explored the game *Word Coach* which leverages a series of word-based puzzles to promote vocabulary learning. The authors found that while students reported English vocabulary learning gains, the benefits waned after the novelty of the game dissipated. Müller (2012) explored the effect of a game in which students were given a patient with symptoms and then needed to pick the correct medication based on the English name and found that vocabulary learned in the game was recalled faster and more accurately than vocabulary learned outside of the game. Peng et al. (2016) compared vocabulary gains among different group orientations, specifically competitive, cooperative, and conjunctive. The authors define conjunctive groups as those whose results are determined by the lowest performing member of the group. They found that for low-achieving students, the conjunctive group orientation led to the highest gains in vocabulary. This study used a whack-a-mole game in which students had to identify the correct translation of a vocabulary word in a limited time frame. In another study exploring English vocabulary development, Wu and Huang (2017) found that students reported higher vocabulary gains when playing a word clearing game similar to *Candy Crush*. This study did integrate the game into the classroom, but rather than teach with the game, the game was used in lieu of traditional instruction. Finally, in a study examining Chinese

vocabulary learning, McGraw et al, (2009) designed and evaluated a game called *Word War*. In the game, learners orally manipulated flashcards to create matching pairs. While the authors found that playing the game resulted in significant vocabulary learning, the learning gains were similar to students who used a non-game flashcard system. The studies presented here focus on games as a motivational tool for rote memorization of vocabulary.

In contrast to games designed to explicitly teach vocabulary in a drill-and-kill format, some games have explored vocabulary learning that occurs implicitly as the result of playing a digital game. For example, Alyaz and Genc (2016) found that participants scored significantly higher on a post-vocabulary test after playing an educational role-playing game designed to teach German. While the participants played the game, they were asked to keep a journal to write down new vocabulary words, pragmatic phrases, and thoughts about the game. The authors mention that there was additional instructional material but did not report on how that material related to the learning outcomes. Similar to the game used in Alyaz and Genc, Dourda, et al. (2014), investigated incidental vocabulary learning that occurred as the result of playing a dialogue driven game in which students try to determine who committed a crime. They found that 45% of the words used in a reflection journal after playing a digital game were previously unknown vocabulary words (Dourda, et al., 2014). Finally, Franciosi et al. (2016) compared vocabulary gains among participants who used a flashcard system (Quizlet) while playing the game *3rd World Farmer* with those who only used Quizlet. They found that those who played the game with Quizlet reported better vocabulary gains on the post-test. The authors suggest that vocabulary learning is improved when students have an opportunity to engage with the vocabulary in multiple contexts.

Research on educational games has shown that vocabulary learning occurs as a result of playing digital games, both when it is explicitly and implicitly targeted. Findings also suggest that adding support while playing the game can further promote vocabulary learning. Adding external support was typically done when researchers were trying to draw attention to form when vocabulary learning was occurring incidentally as a result of reading in game texts. However, it is important to note that external support and in-class interventions are rarely discussed explicitly in these studies. Details on these factors have the potential to provide important information for contextualizing findings as well as implications for teachers interested in using games in the classroom.

2.2 Promoting L2 Readings Skills with Digital Games

Studies exploring the effect of digital games on L2 reading are rare. Poole et al. (2018) explored an interactive fiction game that was designed to promote Chinese reading skills in an elementary dual language immersion program. The authors found that students engaged in more metacognitive activity when they were prompted with a question in the game. Although the game in this study was designed around in-class material, the game itself was not integrated into a classroom setting. Suh et al. (2010) conducted a study using an educational Massive Multiplayer Online Role-Playing Game (MMORPG) called *Nori School*. The authors compared English proficiency gains between a control group that received traditional instruction in the classroom and a treatment group that learned via the

MMORPG in the school computer lab. The authors found that after two months of two 40-minute sessions per week, the treatment group scored significantly higher on a post-reading assessment than the control group. It was inferred that reading gains were the result of reading the in-game dialogue. In a study that examined reading strategies by students playing a digital game in a EFL content- and language-integrated learning classroom, Dourda, et al. (2014) found that students enjoyed the game, received opportunities to develop vocabulary words, and used several different reading strategies including skimming/scanning, translating and transferring, repeating, use of imagery, and association of information and concepts. Research on the impact of digital games on reading skills has found that learning via gaming environments is better than learning via non-gaming environments and that reading via a digital game can promote reading comprehension skills.

The studies reviewed up to this point have demonstrated how drill-and-kill mechanics can lead to vocabulary learning, how in-game dialogue can provide opportunities for students to learn vocabulary incidentally, and how researcher and/or teacher-designed support can promote vocabulary and reading gains. One aspect that is missing in this area of research is how bringing a digital game into the classroom affects the learning environment. Dourda et al. (2014) is one of the few studies that focuses on classroom instruction. It took place in a content and language integrated learning classroom, which shares many similarities to the DLI classroom in the present study. As mentioned above, the authors reported gains in both vocabulary knowledge and reading skills. They also note several instructional/design choices that were made for the in-class lesson that promoted meaningful interaction between the learners. In other words, this study exemplifies how teaching with games, rather than simply learning through games, can provide a dynamic learning environment in which multiple proficiencies are addressed. York, et al. (2021) argues for more studies like this by stating that the DGBLL field is too narrowly focused on game designs rather than on the teachers' role in leveraging games for in class instruction. In the present study, we argue that in order to explore the teachers' role in DGBLL it is necessary to take an ecological perspective towards the integration of digital games in the classroom. While we acknowledge that game design is important, and further that good game design can promote learning, we contend that opportunities for learning can emerge from both within and around the game when games are brought into the classroom. Further, by focusing on how teachers and students engage with games in the classroom the focus can shift from "what game should I use?" to "how can I teach with games?" This is even more imperative when one considers that most of the games reviewed in this section are no longer publicly available. In the next section, we look at what it means to take an ecological perspective to DGBLL and how such perspectives expand what it means to use games for language teaching, rather than simply language learning.

2.3 Ecological Framework

An ecological perspective on second language acquisition and teaching explores the relationship between the student and the environment and how opportunities for learning emerge from that relationship (van Lier, 2004). These views were derived from research in psychology that explores both how individuals are nested within several ecological levels (e.g., micro-level, meso-level, macro-level) that mutually interact

(Bronfenbrenner, 1979; Douglas Fir Group, 2016) and how environments provide individuals with opportunities to act through perceived affordances (van Lier, 2004; Thoms, 2014). Kramsch and Steffensen (2008) state that taking an ecological approach means acknowledging that language "is not studied as an isolated, self-contained system, but rather in its natural surroundings" (p. 18). They go on to highlight that language learning is interconnected, interdependent, and interactional, illustrating how the individual is part of several micro and macro-ecosystems that affect the learners and conversely are affected by the learner. Accordingly, researchers who take an ecological perspective place a stronger emphasis on the context of the study and often see themselves as a participant in the environment and thus part of the investigation (Kramsch & Steffensen, 2008).

Similarly, van Lier (2004) argues that capturing language learning in the classroom is incredibly complex, but also necessary. He further suggests that approaches that isolate variables as evidence for learning often fail to acknowledge this complexity and thus, many of the conclusions drawn from such approaches become less relevant to teacher practices (p.11-12). In contrast to these approaches, van Lier focuses on how individual perception of and interactions with the environment may lead to opportunities for learning. This approach not only acknowledges the role of the environment, but more importantly how the individual perceives and engages with the environment to create opportunities for learning. This perspective places a large emphasis on perception, as it is the perception of opportunities within an environment that lead to action and/or learning. Gibson (1979) called these opportunities to act *affordances*. He states that affordances are what the environment "offers the animal, what it provides or furnishes, either for good or ill" (p. 127). van Lier applies this concept of affordance to the L2 classroom to argue that learners are not simply passive recipients of language; rather, through their unique perceptions, they actively attend to and engage with language and resources in the classroom to make meaning. It is important to note that that these affordances are not simply present in the environment, but rather they emerge as a result of interaction with the environment (Thoms, 2014). For example, Thoms found that teacher reformulations of student utterances provided three types of affordances for student learning in a language classroom. These affordances emerged as a direct result of the teacher interacting with students to enhance the learning environment.

A few DGBLL studies have applied an ecological perspective to explore how online gaming environments afford opportunities for L2 use and learning. Rama et al. (2012) analyzed gameplay by two novice-Spanish learners playing *World of Warcraft*. The authors identified three unique affordances that emerged from gameplay, specifically that the environment created a safe space for using their language skills, promoted communicative competencies, and encouraged goal-directed actions. Zheng et al., (2012) reported similar affordances after analyzing English language learners' chat logs and gameplay in *World of Warcaft,* however they also noted the value of exploring player actions as a form of value realizing within these digital worlds. Thorne et al., (2012) illustrated through an ecological perspective how opportunities emerged not just from within the game, but also around the game. The authors found that Dutch learners of English engaged with *World of Warcraft* forums in which players from around the world discuss game knowledge and strategies. Further, they analyzed these interactions to

demonstrate the text complexity and subsequently the opportunities for learning and development that exist within these auxiliary environments.

Past DGBLL studies and other studies exploring affordances within learning environments have primarily focused on how the learner perceives the environment (e.g., Jin, 2018; Thoms & Poole, 2017). However, as Liu and Chao (2018) state, "learners and teachers may need to work together in order to perceive, take action, and bring about the best possible learning experience" (p. 3). In their study, Liu and Chao highlight several ways in which teachers can highlight and enhance potential affordances for language learners. However, teachers must first perceive and/or recognize the affordances to do this. This suggests that when exploring affordances of an environment or integrating a new technology into the environment, one should consider both teacher and student perceptions and further how those perceptions interact.

Taking an ecological perspective acknowledges that the environment affords opportunities to act. Typically, these affordances have been assumed to be only noticed by the learner in educational settings and indeed the learner must notice these affordances in order to leverage them for learning. However, such a narrow view ignores the role of the educator who, presumably, is also concerned with student learning. In classroom contexts, both the teacher and student examine the environment and look for opportunities that will benefit the learner. The teacher looks for meaningful ways to engage the learner, ways to make learning more salient, and ways to promote positive affect to encourage learning. Likewise, the learner is looking for ways to make meaning, ways to practice their emerging skills, and ways to regulate their own learning. Thus, with one common goal for the student to learn the language, the teacher and student are often acting in unison. In the present study, we attempt to illustrate how digital games, and more specifically the act of bringing digital games into the classroom, can act as a mediator for this common goal. The game itself can afford opportunities for action by both the teacher and student, action that can lead to and/or support positive language development.

Thus, in the present study we intend to provide a detailed account of the game design, the classroom implementation, and the teacher-student interactions around the game to illustrate the ecological affordances of bringing a digital game into the language classroom. In this study we do not explore the effect of individual game design mechanics on learning, rather we explore the impact of the intervention as a whole by exploring pre and post vocabulary and reading comprehension assessments as well as the opportunities that emerge for learning around the game. The present study is guided by the following research questions:

1. Do students who play the digital game show learning gains in vocabulary and/or reading comprehension, as measured by pre-and-post assessments?
2. Is completion of the supplemental material associated with learning gains?
3. What pedagogical affordances emerge when integrating the digital game into the classroom?

3. Methods

This study is part of a larger project that explores use of digital games as stealth assessments (Poole, 2020). It is important to note that this project is a collaboration between the first author and the primary teacher. The first author worked closely with the primary teacher in order to understand the learning needs of the DLI students. The first author then designed the game iteratively soliciting feedback from the teacher. The first author had spent a lot of time in the DLI classrooms and thus co-taught the class with the primary teacher. Both the first author and primary teacher introduced the intervention, helped troubleshoot technology problems, and provided support and feedback in Chinese while students played the game.

3.1 The Game: Legend of the Dragon

The game used in the present study is called *Legend of the Dragon (龙之传说)* and was designed and built by the lead author using *RPG Maker MV*. In this single-player role playing game, students take on the role of an adventurer who sets out on a quest to aid the last dragon in China. Along their quest, students meet non-player characters (NPCs) who provide information, present quests/tasks, and direct students towards the last dragon. The game world consists of five major Chinese cities (Beijing, Harbin, Shanghai, Chengdu, and Xi'an) and several fictional villages and dungeons placed in proximity to the cities. The game world was designed to resemble the geographic shape of China with cities located in their approximate real-world locations (see Figure 1).

All players start in Beijing and after completing the initial tutorial are given the quest to retrieve a book in Xi'an. Once players retrieve the book, they learn that the last dragon in China is sick and they need to find three components (dragon blood, dragon scales, and dragon bones) to concoct a potion that is believed to help the last dragon recover from the illness.

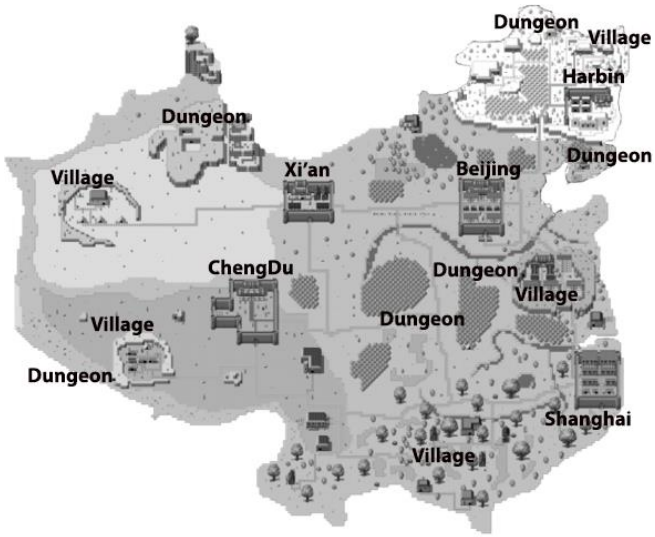

Figure 1. Over World Map of Legend of the Dragon

3.1.1 Dialogue

To complete quests and in-game tasks, players have a set of cards, items, and skills at their disposal. These in-game features include a language support mechanism in the form of a glossing system (W. Hong, 1997; Poole & Sung, 2016) that provides the Pinyin, a phonetic representation of Chinese characters. This particular DLI program had a strict policy against translating in the classroom and thus definitions were not provided in the glossing tool. Glossing tools have been shown to support reading fluency (Shen & Tsai, 2010; Xie & Tao, 2009) and improve reading comprehension (W. Hong 1997; J. Wang, 2009, 2012; J. Wang & Upton, 2012). The glossing system was implemented to support both vocabulary learning and reading comprehension. Further, past studies have shown that prompting learners to respond to in-game dialogue can promote positive metacognitive reading strategies (Poole et al, 2018).

Figure 2. Glossing Tool

3.1.2 Quests

The quests involve a variety of puzzles, pick-up/delivery tasks, and enemy battling/taming activities. For example, one of the first quests that a player is given (see figure 3) is to retrieve a sword for a weaponsmith. The sword is located in the weapon smith's home which is demarcated with a sign.

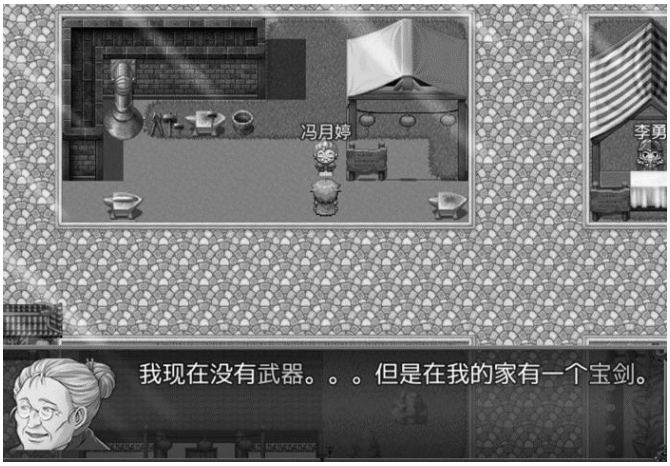

Figure 3. Sword Retrieval Quest

Players also must solve puzzles that utilize their language skills. For example, in the puzzle below students must read the text from a sign that indicates a sequence of colors and then activate the orbs in the correct order to open a gate.

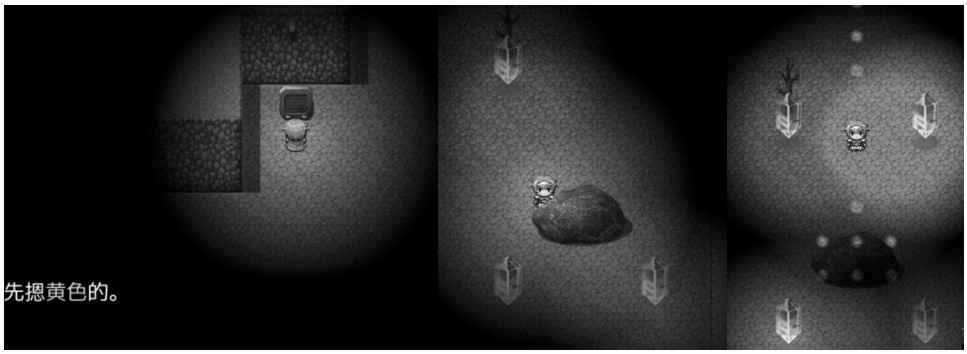

Figure 4. Sequencing Quest

In a similar puzzle the player must match the color of the boulder with the correct sign to open a gate to the final boss.

Figure 5. Matching Quest

Through a series of text-based dialogue that direct the players in the correct direction and mini-puzzles or language-based tasks, the player can complete the quest. These quests were designed to make the text meaningful and thus promote a learner's attention to what is being read.

3.1.3 Battle System

While exploring the game, players must navigate through several baddies spread throughout the fictional world. The baddies are one of 20 different animals, and each baddie has a special type of attack, strength, weakness, and preferred food. This information can be found on baddie cards that players collect by either defeating or taming a baddie. When players come into contact with a baddie, they have two options: battle or

tame. If they choose to tame a baddie, they can do so by giving the baddie it's preferred food. To battle a baddie, players again have two options: attack or summon a pet. All players have a base attack ability, but the base attack ability is very weak. Even when collecting swords, armor, and/or rings the players base attack is barely enough to defeat lower-level baddies. This was a conscious game design choice made to encourage the use of baddie cards which allow the player to summon a pet to fight by their side. However, it's important to note that players must collect at least five cards before they can learn the skills to summon a particular pet. Once the skill is learned they need a card each time they summon a pet. This was done to encourage the use of different pets. Rather than simply summon one pet every time, players would need to summon different pets as their cards became available. Further, certain pets' strengths are better when fighting baddies with similar weakness. This game mechanic was thought to encourage the students to read the information on the animals' cards to learn which pets should be summoned in certain battles. Thus, regardless of whether students engaged in battle or if they chose to tame a baddie, they would need information on the cards.

The design of this game relies heavily on principles associated with Focus on Form which suggests that L2 learners should be primarily focused on meaning while educators/designers use implicit strategies to draw attention to form (Long, 1997). To play the game, learners are required to process meaning to complete tasks, quests, and/or battle. However, the in-game glossing system, dialogue prompts, and input enhancements all help draw attention to targeted language forms.

3.2 Classroom Implementation

3.2.1 Supplemental Materials

Supplemental materials in the form of a paper-based workbook written in Chinese were specifically designed to promote character recognition, oral discussions around game items and places, and note-taking in terms of in-game exploits. The workbook provided two to three language activities for students to complete in the classroom. These language activities included a character writing task, which asked students to write commonly seen characters in the game three times. Past research has noted the positive effects of writing practice on character recognition skills (Guan, et al. 2011; Xu, Chang, Zhang, & Perfetti, 2013). A second task asked learners to match images to vocabulary words to further promote vocabulary learning. Finally, discussion questions asked learners to use the targeted vocabulary words to discuss features of the game (e.g., Where do you find the battle cards?), game items (e.g., What sword color does the most damage?), gameplay strategies (e.g., Which partner animal is best?), and quests (e.g., What quest does Sima qian give?). The workbook also contained a printed world map that students were encouraged to keep notes on. The workbooks were collected at the end of the project and were reviewed based on completion of exercises. Approximately 82% of the students completed the exercises in the workbook each day.

3.2.2 Teachers' Role and Classroom Implementation

During the integration of the game into the classroom, the researcher took on an instructor role, and the primary teacher of the class took on a support role during gaming sections. However, the primary teacher first introduced the project to their students then directed students into groups. This was done given the researcher's familiarity with the game and teaching with games. The primary teacher of this class was very much interested in teaching with games and thus also played an active role during the intervention. During gameplay both the researcher and teacher provided support while students played the game. On the day of the intervention, the researcher provided an overview of the tasks in the workbook. In the following weeks, students were able to complete most of the assigned workbook tasks without further support. In terms of gameplay, in the first week, the researcher and teacher both walked around the room, from group to group to provide technical and basic gameplay support while students played the game. In the following weeks, the researcher and teacher interacted with students while they played by answering student questions about the game, asking questions about player progress, providing hints, and reminding learners of quest tasks as they played. Due to IRB regulations, we were not able to use the teacher's data because we did not request consent as part of our original protocol. While the primary teacher did engage with the students, we were not able to use that data in this analysis. We also acknowledge the pedagogical implications of the researcher taking on an instructor role. As mentioned above, the researcher had already established a collaborative partnership with the primary teacher and the DLI program.

3.3 Research Design

3.3.1 Participants and Setting

This study took place in two sixth-grade Chinese DLI classrooms (19 and 21 students, respectively) located in a rural town in the western U.S. The school used stratified randomization with gender as a factor to assign students to each classroom at the beginning of the school year. Students ranged in age between 10 and 12 years old (mean = 11.05). There were complete data from 32 students. See Table 1.

Table 1. Students Included in Data Analysis

Class	$N_{students}$	Survey data
A	20 (10F, 10M)	20 Pre, 19 Post
B	16 (9F, 7M)	14 Pre, 15 Post
Total	36 (18F, 16M)	34 Pre, 34 Post

Note. Only 32 complete cases.

3.3.2 Procedures

On the Friday prior to gameplay, participants completed the paper-based pre-assessment. On the first day of gameplay, the participants were given a brief tutorial on how to play the game via whole-class demonstration. The classroom teacher then illustrated

how the game related to their current studies by telling the students that vocabulary in the game was primarily comprised of review words and that the game was similar to their current in-class readings about students who were traveling to China. Similarly, in the game the students would be going to China and could explore the same places that the characters in their books were visiting (e.g., Beijing, Xi'an, Chengdu).

Students played the game on MacBook laptops. In order to maintain a 1:1 computer to student ratio, the primary teacher divided the class into four groups of five students each. Each group contained a mixture of high and low proficiency learners (as identified by the primary teacher). Students played the game for 50 minutes (two 25-minute sessions) and completed supplemental materials for 50 minutes (two 25-minute sessions) per week over the course of a four-week period. Students were administered the paper-based post-assessment two days following the final game play session.

3.4 Data Collection

Data for the present study came from six sources: audio recordings of the classroom during gameplay, pre- and post-vocabulary assessments, and pre- and post-reading comprehension assessment, and student workbooks. While students played the game, audio recorders were used to capture in-class dialogue around the game. Audio recorders were placed at each of the four tables in both classes while students played the game and were collected for all eight sessions of game play. Informed consent was not obtained for the primary teacher of this class prior to the study; thus, only interactions between the researcher and learners were analyzed. This will be further discussed in the limitations section.

The pre- and post-vocabulary assessment consisted of 45 words out of 326 words that learners could potentially be exposed to via the glossing system while playing the game. These words were selected because they were both deemed important to the overall storyline in the game and relatively unknown to the students were added to the assessments. On the vocabulary assessments, learners were prompted to enter the pinyin and the English translation for a given word. These assessments were scored by awarding 1 point for correct pinyin, and 1 point for correct English definitions. Half points were awarded for partial answers. For example, if a learner correctly identified the correct pinyin or English for one of the characters but not both, half points were awarded. Awarding partial points for vocabulary knowledge was viewed as valuable given past research that has noted the non-linear trajectory and partial accumulation of vocabulary knowledge that occurs through incidental learning while reading L2 texts (Pigada & Schmitt, 2006).

The reading comprehension assessment was adapted from the Youth Chinese Test (YCT) (http://english.hanban.org/ node_8001.htm), an official Chinese proficiency assessment developed by the Confucius Institute and used regularly by the Chinese DLI program that served as the context for the present study. The assessment consisted of 10 items. Although the format of the assessment was adapted to reflect the YCT, the content was adapted to reflect text that the learners might see in the game. To reduce the priming effect on the reading comprehension assessments, items were randomized in both the pre-

and post-assessments. Further, although the sentence structures remained the same, key vocabulary words, and thus the answers, changed from pre- to post-assessments.

4. Data Analysis

4.1 Quantitative Data

To answer the first research question which investigates whether learning occurred during the intervention, paired samples *t* tests were used to compare pre- and post-vocabulary and reading comprehension scores. There were no outliers in the difference scores for the reading comprehension assessments or the vocabulary assessments. The distributions of the difference scores for both assessments also satisfied the normality assumption as assessed by the Shapiro-Wilk test. Cohen's d, a standardized measure of the differences between the means, was used to calculate the effect size.

The second research question investigates the role of the workbook as scaffolding to support learning. To do this, students were given a score from 0 to 2 to indicate if they completed the workbook tasks for each associated day. 0 was given for no work done, 1 was given for partial completion, and 2 was given for workbooks that were completed. A correlation coefficient was computed to determine if there was a relationship between workbook scores and the reading and vocabulary gain scores. To further explore this relationship and control for learner proficiency, a simple stepwise regression with student pre-scores as the covariate was conducted. Again, there were no violations of assumptions of normality, linearity, multicollinearity, and homoscedasticity.

4.2 Qualitative Data

The third research question explores the affordances that emerge during game play. Similar to Thoms (2014), *affordance* is defined as any "discursive move (or series of moves) involving a teacher and/or a student" (p.729) that emerges while students engage with the digital game. These are opportunities to act within the language classroom that are perceived and acted upon by either the teacher or student during gameplay.

To explore affordances that emerge during gameplay, multiple rounds of coding utterances involving discursive moves between the researcher and students were conducted. First, a round of open coding was conducted by the first two authors to identify patterns, themes, and categories in the data (Saldaña, 2015; Strauss & Corbin, 1998). In the second cycle of coding, axial coding was employed (Patton, 2014; Strauss & Corbin, 1998) to focus on organizing the codes into categories that best explained the types of affordances identified. This round of coding involved iterative cycles of review and revision to achieve saturation of categories. At the end of this second cycle, ten codes were organized into seven categories.

In order to conduct inter-coder reliability, an additional person, a native Chinese speaker who has worked with the primary teacher and participants and has taken graduate courses in qualitative methods, also coded the data. Prior to coding, the first author

provided this additional coder with the code book (see Table 2). Then, they discussed the data, codes, and definitions and how to code.

Table 2. Code Book: Description and Example of Affordances

Affordance	Description	Example
Quest Management	Direct learners towards to the next quest or next part of a quest.	但是你先得把地图还给那个人。 [[But you need to take the map back to this person first.]]
Battle strategy Discussion	Discuss strategies related to winning a battle.	你不应该用猴子，应该用蝙蝠。 [[You shouldn't use the monkey, you should use the bat.]]
Encouragement	Encourages a player to explore the game or read a text on their own.	这个书很重要，你必须看懂了，才知道下一步是什么 [[This book is really important, you have to understand to be able to move on to the next part.]]
Technology Support	Shows player how to play the game or helps with a technical problem related to the game.	你得保存. [[You must save the game.]]
Confirmations	Confirms a question or belief about the game.	猪，对，你要抓三只猪。 [[Pig, Right, You need to catch three.]]
Meaningful Communication	Discuss current status of the game, object in the game, and/or results of an event in the game.	他马上要赢了。他很快就赢了。 [[He's going to win, soon, he'll win!]]
Linguistic Support	Helps student read a text or provides a translation to a word.	战斗，战斗就是打仗。 [[Battle, battle is just like fighting.]]

After receiving training, the coder was provided with 20% of the utterances to code. Cohen's κ =.74, indicating a "moderate" level of agreement (McHugh, 2012). Any discrepancies between the codes were then discussed between the two coders and applied to the remaining utterances.

5. Results

To answer the first research question, pre- and post-assessment scores for both the vocabulary and reading comprehension measures were compared using *t* tests, see Table 5.

Students reported significantly higher vocabulary scores on the post-assessment (M = 27.95, SD = 17.97) than on the pre-assessment (M = 18.31, SD = 14.38), which indicated that significant growth did occur as a result of the intervention, $t(31) = 9.99$, $p < .001$).

Table 5. Learning Measures

	Pre				Post					
Measures	*M*	Med	*SD*	*n*	*M*	Med	*SD*	*n*	*t* test	Cohen's D
Vocabulary	18.31	16.00	14.38	32	27.95	23.50	17.97	32	9.99***	0.45
Reading comprehension	3.41	3.00	2.56	32	4.72	4.50	2.43	32	3.22**	0.54

Note. Vocabulary Scale from 0-90. Reading scale 1-10. Both effect sizes are medium.
** $p < .01$. *** $p < .001$.

The effect size was .45, a medium effect size for educational interventions such as this one. In other words, after eight 25-minute gaming sessions along with supplemental workbooks, the students in this sample gained, on average, about 10 points of vocabulary knowledge. This translates roughly into a five-word increase.

Similarly, students reported significantly higher reading comprehension scores on the post-assessment (M = 4.72, SD = 2.43) compared to the pre-assessment (M = 3.41, SD = 2.56), indicating that students' reading comprehension also increased significantly, $t(31)=3.22$, $p < .01$). The effect size was .54, a medium effect size. Students in this sample gained, on average, slightly more than 1 point on the reading comprehension assessment after the intervention. These findings will be further contextualized in the discussion section.

Next, to determine if completion of the workbook was associated with vocabulary learning or reading comprehension gains, scores derived from workbook completion were positively correlated with both gain scores. There was not a significant correlation between workbook completion and vocabulary gains R=0.28 (t=1.61, df=30, p-value = 0.12). Similarly, when controlling for pre-vocabulary test scores, the workbook was still not significantly associated with vocabulary gains.

However, workbook completion was significantly associated with gains on the reading comprehension test R=.40 (t=2.44, df=31, p-value=0.02). When controlling for pre-reading comprehension test scores, workbook completion was associated with higher gains on the reading comprehension test (See Table 6). A one-unit increase in workbook completion was associated with a .651 increase in reading comprehension scores.

Table 6. Stepwise Regression for Scaffolding Effect on Reading Comprehension Gains

	Reading Comprehension Gains	
Pre-Reading Comprehension Scores	-0.520** (-0.809,-0.232)	-0.637*** (-0.870,-0.404)
Scaffolding (Workbook)		0.615*** (0.345, 0.886)
Constant	2.932*** (1.711, 4.153)	-2.748 (-5.424, -0.071)
Model Fit (ChiSq		0.000***
Observations	33	33
R^2	0.287	0.571
Adjusted R^2	0.264	0.543
Residual Std. Error	2.103 (df = 31)	1.658 (df = 30)
F Statistic	12.483** (df = 1; 31)	19.976*** (df = 2; 30)

Note: * p <0.05; **p<0.01, ***p<0.001

Finally, the third research question was answered by analyzing the interactions between the researcher and students during gameplay sessions. After coding the data, seven types of affordances were identified during the four weeks of gameplay. Recall that affordances in the context of this study are discursive moves between the researcher and student that emerge as a result of playing the digital game in a classroom setting. Table 7 provides an overview of the frequency and percentages of the categories identified in this study. A description of the affordances and examples are provided below.

Table 7. Types of Support Provided during Gameplay

Affordances	Frequency	%
Quest Management	98	28.1
Battle Strategy Discussion	71	20.3
Meaningful Communication	70	20.1
Encouragement	53	15.2
Technology Support	53	15.2
Confirmations	23	6.6
Linguistic Support	13	3.7
Total Utterances	348	

Note. Some utterances contained multiple codes and thus the total utterances do not reflect the total number of codes.

5.1 Quest Management

The most frequent type of affordances was *Quest Management*. This affordance involved the researcher prompting students to start a quest, directing them to the next part

of a quest, or reminding them of their progress in a quest. It emerged either by the student asking what they should do next or by the researcher noticing that a student was struggling. In the example below, a student was collecting items in the starting city and picked up a flower. This student wanted to know what the flower did.

Student: 它会做什么？ [[What does this do?]]

Researcher: 你问这个人在下面，你问这个人她会告诉你它会做什么. [[Ask this person down here, you ask this person, and she will tell you what it does.]]

The researcher took this opportunity to direct the student towards the start of a quest in the tutorial. The flower that was being collected by the student was an item that was required to complete a quest. Note that because the game was brought into the classroom, this afforded an opportunity for both the student to request support and for the researcher to direct the learner towards the student's in-game goal.

5.2 Battle Strategy Discussion

The second most frequent affordance came in the form of *Battle Strategy Discussions*. These were instances when the students either wanted to discuss strategies for winning a battle, or if the student was about to lose a battle and the researcher provided a hint or insight. For example, when walking by a student, the researcher noticed that the student was about to lose a battle to a spider that was a much higher level than the student's character.

Researcher: 你死了？[[Did you die?]]

Student: Yeah.

Researcher: 他喜欢吃虫子。你有虫子吗？[[He likes to eat bugs. Do you have bugs?]]

Student: 没有 [[No, I don't have any.]]

Researcher：他很厉害，你不应该跟他打 [[He's strong. You shouldn't fight with that one yet.]]

Here the researcher leveraged this opportunity and provided a hint that spiders like to eat bugs, so that next time when the student encounters the spider, she can feed it bugs rather than engage in battle. The researcher reminded the student that she should fight with lower-level baddies. This affordance provided an opportunity for meaningful exchanges around the game as these discussions targeted the common goal between teacher and learner within the game.

5.3 Talk Around the Game

This affordance included moments when the researcher was asking about either current progress or activities that a student was engaging in while playing the game or comments about the status of the game. Comments about the game included talking about items that the learners acquired, character levels, or the results of battles (e.g., 你真厉害 [[You're awesome!]]. For example, on the last day of the study, one student figured out that purple items were the best items in the game, but this particular student was unable to find the purple sword. While searching in Chengdu, this student loudly notified the researcher that the purple sword was not there.

> Student: 他们没有 [[They don't have it here.]]
>
> Researcher：这个就关门了， 你去西安。 西安应该有。[[That one is closed. Go to Xi'an. Xi'an should have it.]]
>
> Student：但是他们没有紫色的 [[But they don't have the purple one.]]
>
> Researcher：就是那儿，应该有。对不起，哈尔滨有， 我忘了。 [[It is there, they should have it. Oh sorry, it's in Harbin, I forgot.]]

As the student continued to search for the sword, the researcher started making suggestions on where the sword might be and first suggests Xi'an. The student remembered that it was not there, this prompted the researcher to suggest Harbin. Again, similar to the first two affordances, discussions around the game provided opportunities for meaningful communication that is contextualized within the game.

5.4 Encouragement

The *Encouragement* affordance occurred when the researcher simply suggested that the students carefully read a text or explore a part of the game. This happened when the researcher felt that a particular text was really important. For example, one student was confused about what she should do next and asked the researcher for help. Upon further investigation, the researcher discovered that the student had acquired the Dragon book, which sets up much of the story, but had not opened it. So, the researcher helped the student open the book and then encouraged her to carefully read what was inside.

> Researcher: 所以你现在，你看这，你有龙之书，你要看他，好好看。 [[So now, you have to read this, you have the Dragon Book, you have to read it. Carefully read it.]]

It is not uncommon for some players to skip text in order to progress more quickly through games. Bringing a game into the classroom and using it as part of instruction creates opportunities to encourage closer reading of in-game texts.

5.5 Technology Support

The technology affordance involved moments when either the student had a problem with the user interface or a student needed help with the game controls. For example, in the first few game sessions there were questions about saving the game, how to use the cards, access the control menu, how to "put on" equipment in game, and how to look up vocabulary with the glossing system. This led to the researcher showing students how to restart the game, point out where things were in the menu, or simply telling the student to use the "control" key to look up an unknown word.

5.6 Confirmations

This affordance includes moments when students wanted confirmation about what they were doing. For example, one of the quests in the game has students rearrange a set of tombstones to collect a prize. In the dialogue the word tombstone is glossed, thus provides pinyin for the student. The student did not know this word before playing, but given the context of the game, wanted to confirm that the three tombstones in the game were in fact tombstones. The student first asked his classmates, and then confirmed with the researcher.

> Student: 这个是墓碑？ [[This is a tombstone?]]
>
> Researcher: 是的，这三个都是墓碑 [[Yes, those three are all tombstones.]]

This is another example of an affordance associated with bringing games into the classroom. Here the student leverages multiple support features (e.g., peers and teacher) from within the classroom to confirm a hunch.

5.7 Linguistic

The linguistic affordance was the least frequent affordance identified. This came when students had direct questions about unknown words. These were usually words that were a part of the game rather than part of the students' in-class vocabulary. For example, one student asked what 战斗 [[*Battle*]] meant, to which the researcher said, 战斗，战斗就是打仗。 [[Battle, battle is the same as fight]]. Similarly, another student wanted to know what 蝎子 [[scorpion]] was, to which the researcher said, 蝎子是，看，它的尾巴。 [[Scorpion is, here look, it's tail is …]] while mimicking a scorpion's tail with his hands. The implications for these findings will be further discussed in the following section.

6. Discussion

While the L2 field has seen an increase in studies on games and L2 learning, there are very few studies that focus on what it means to integrate games into L2 classroom instruction. There are even fewer studies that look at L2 games that target Chinese in

elementary classrooms. In the present study, the lead author first designed a game to promote Chinese reading comprehension and vocabulary learning in sixth grade DLI classrooms and then integrated it into the classroom in collaboration with the primary teacher.

The first research question explored whether or not students learned by interacting with the game and supplemental activities in the classroom. The results indicated that students had significant gains in vocabulary after participating in the project. On average, students gained approximately 10 points on the vocabulary knowledge assessment which roughly translates to five words. While five new words in this study may not seem like a large gain over the course of four weeks, these were similar to other studies exploring vocabulary gains in an educational game. For example, Chen and Yang (2013) found a significant increase in vocabulary knowledge after 1.5 hours of gameplay and notetaking. The significant difference was equivalent to a gain of two new words. In another example, Alyaz and Genc (2016) allowed preservice teachers to play an educational game for the last part of class for 8 weeks. They also reported significant vocabulary gains equivalent to 5 learned words over the 8-week period. It should be noted that both of these studies were working with adult learners of English as a second language. In addition, students in the present study were only assessed on 45 vocabulary words. Given that students were potentially exposed to 326 new words in the glossing system during the 4-week intervention, they may have learned words that were not among the 45 assessed.

Additionally, students in the present study were not specifically told to focus on vocabulary learning while playing the game as was done in other studies investigating Chinese vocabulary learning in a digital environment (e.g., Hsiao et al., 2017; Lan et al., 2015). Thus, the increases in vocabulary knowledge can be seen as being learned incidentally, or as "a by-product, not the target, of the main cognitive activity" (Huckin & Coady, 1999, p. 182). Incidental vocabulary learning that occurs in reading has been argued to be a better approach for increasing vocabulary knowledge because the words are contextualized in text and learners have the opportunity to improve reading skills while learning vocabulary (Huckin & Coady, 1999; Krashen, 2004). However, tracking incidental vocabulary learning while students read a text can be difficult given that learners often report gains in partial knowledge of a word (Horst, 2005; Pigada & Schmitt, 2006), much like in the present study.

In addition to increases in vocabulary, the present study also found significant increases in reading comprehension scores. On average, students scored approximately 1.3 points higher on the post-assessment than on the pre-assessment and a medium effect (Cohen's D) was found for this increase. This is likely due to the sheer amount of exposure to texts that students had during this intervention. On average, students were exposed to 549.5 texts in eight 25-minute gaming sessions (Poole, 2020). Dourda et al. (2014) also integrated a game into the classroom context and while they did not measure reading comprehension on pre- and post-assessments, they did conduct classroom observations and noted that repeated exposure to large amounts of in-game texts led students to employ a variety of reading strategies, which improved their reading skills over the course of the 8-week project.

The second research question explored the effect of completing a workbook that was designed to complement gameplay. Results indicated that workbook completion was not associated with vocabulary learning in the game but was associated with reading comprehension gains. In terms of vocabulary gains, this finding is different from other studies that found that additional support outside of the game was beneficial for vocabulary learning (Franciosi, et al., 2016; Hitosugi, et al., 2014). A possible reason why the present study did not find a relationship between complementary activities and vocabulary gains may be because the game itself provides vocabulary support via glossing system. In other words, learners who did not complete the workbook may have similar vocabulary gains with those who did, because they took advantage of the glossing system in the game. The workbook may have promoted reading comprehension gains because it provided learners with a space to record their progress on quests. These opportunities to reflect and journal about their gaming experiences may have led to more interest and motivation to read dialogue in the main quest, however more research is needed to confirm these conjectures.

Finally, the third research question explored affordances that emerged when integrating a digital game into a DLI classroom. By exploring the integration of a digital game into a classroom context from an ecological perspective, the focus shifts towards how the introduction of a game into the classroom setting provides opportunities to act that support and/or promote learning. It is not enough to simply report on learning in games, instead the goal is to understand what affordances, or opportunities to act and engage in the content, emerge when the game is integrated into the environment. Further this perspective provides an expanded view on the potential use of games in L2 education. Rather than viewing games as a challenge in design, an ecological perspective explores how both instructors and learners leverage the game to provide opportunities to engage in teaching and learning.

The present study identified seven affordances that emerged while students played a digital game in the classroom. These affordances can be broadly parsed into two categories: game literacy and language support. Students who demonstrate strong game literacy "are able to recognize the game's rules and generate strategies to meet the goal of the game" (Hsu & Wang, 2010, p. 407). This first category includes *Quest Management*, *Battle Strategies*, and *Technical* affordances which involve help and discussion around learning game mechanics. On one hand, these affordances could indicate a lack of gaming experience by the players. In a review on using games for vocabulary learning, Yudintseva (2015) argues that players need scaffolding to learn new game mechanics and cultural norms in-games. On the other hand, for game designers, these affordances could indicate poor game design that did not allow players to learn on their own through in-game scaffolding. However, from an ecological perspective, it can be argued that these affordances provided opportunities for meaningful discussions around the game in Chinese. In other words, by playing the game in the classroom, students were afforded an authentic context for meaningful L2 speaking practice. Not captured in this study were the conversations between peers around the game as well. If games are designed to be stand-alone learning tools, in which players do not need support or simply engage in solo-play, these opportunities for rich L2 interactions will be lost.

The second category of affordances refer to generic L2 supports and includes *encouragement, confirmations, talk around the game, and linguistic affordances.* The encouragement affordance pushed learners to read on their own and focus on important texts. Confirmations allowed for quick reassurances that a player was on a correct path or understood a text. Similarly, linguistic affordances allowed players to gain quick access to vocabulary knowledge and then to return to the text and in some cases linguistic affordances allowed for additional discussion around a word. Finally, the *talk around the game* allowed learners and teachers to use the game as a mediator for discussion (Poole et al., 2019). Teachers were able to point to different parts of the game or the student's character in the game and make a simple comment that sometimes led to a further discussion. Likewise, learners often pointed to their own characters and games to highlight a new item or place that they found. In summary, these affordances provided further opportunities for L2 vocabulary, reading, and oral language learning.

There are several limitations that are associated with this study. First, although both the researcher and teacher engaged with students during this intervention, only support from the researcher was transcribed and analyzed. As noted above, the researcher functioned as an instructor who is very familiar with the game given his role as designer and developer of the game. Future research should explore how teachers, who may not be gamers or have insider knowledge of the game, interact with learners when playing L2 games and how such interactions afford new opportunities for learning and engaging with the L2. Second, only audio data was collected and thus it was difficult to identify specific students associated with each teacher support utterance. Thus, it may be that certain affordances only emerged as a result of student differences. For instance, there were some students that never requested help within the game. Additionally, it should also be noted that some audio was incomprehensible. When this occurred, a second audio recorder was checked for clarity. However, there were some researcher-student interactions that were not captured. Finally, there was no control group or delayed-post assessment in this study, thus the generalizability of the results is limited, and it is unclear how long the learning gains were retained.

7. Conclusion

Research on games in L2 contexts has suggested that learners need additional support to develop their language knowledge and skills via gaming. However, few studies have explored how educators can/should integrate games into a classroom context where this support may be given. For digital games to reach their full potential as an educational tool, it is imperative that researchers continue to explore ways to integrate them into the classroom and further how teachers can leverage games to enhance L2 instruction. In the present study, we do not attempt to parse out the specific role of the game in relation to learning. Instead, we explore how integrating the game into the classroom allows for the teacher to design activities and interact with the students around the game in unique ways. It is likely a combination of the game design and the affordances that emerged within the classroom that led to learning gains in this study. The affordances that emerged were coded into seven categories and then more broadly into gaming literacy and linguistic supports. These affordances further provided Chinese language learners with an opportunity to use

their oral language skills in a meaningful way while also continuing to develop their vocabulary and literacy skills in a contextualized, task driven approach within the game. These dynamic and integrated learning environments are imperative for Chinese DLI learners who are expected to develop both subject content knowledge as well as language skills. By providing details on the game, in-class tasks, and instructor-student interactions, this study provides a model for how teachers may use games to create rich learning environments for Chinese DLI learners.

Further, studies should explore how positioning games within a curriculum or leveraging in-game content to reinforce content taught outside of the game affects learning. Finally, from an ecological perspective it should be explored how affordances identified in this study differ from the integration of another media source. In other words, were these affordances simply the result of teacher mediation or is there something inherently different about digital games that allow for the interactions that were identified in this study.

References

ACTFL. (2012). *ACTFL performance descriptors for language learners 2012 edition*. American Council on the Teaching of Foreign Languages

Allen, J. R. (2008). Why learning to write Chinese is a waste of time: A modest proposal. *Foreign Language Annals*, *41*(2), 237-251.

Alyaz, Y., & Genc, Z. S. (2016). Digital game-based language learning in foreign language teacher education. *Turkish Online Journal of Distance Education, 17*(4). 130-146.

Ang, C. S., & Zaphiris, P. (2006). Developing enjoyable second language learning software tools: A computer game paradigm. In P. Zaphiris & G. Zacharia (Eds.), *User-centered computer aided language learning* (pp. 1-22). Idea Group.

Ansteeg, L. W. (2015). Incidental lexicon acquisition through playful interaction. *International Journal of Emerging Technologies in Learning (iJET), 10*(1). 4-10.

Baltra, A. (1990). Language learning through computer adventure games. *Simulation & Gaming*, *21*(4), 445-452.

Bronfenbrenner, U. (1979). *The ecology of human development*. Harvard University Press.

Burkhauser, S., Steele, J. L., Li, J., Slater, R. O., Bacon, M., & Miller, T. (2016). Partner-language learning trajectories in dual-language immersion: Evidence from an urban district. *Foreign Language Annals*, *49*(3), 415-433.

deHaan, J. (2019). Teaching language and literacy with games: What? How? Why? *Ludic Language Pedagogy* (1), 1-57.

Cobb, T., & Horst, M. (2011). Does word coach coach words? *CALICO Journal, 28*(3), 639-661.

Dalton, G., & Devitt, A. (2016). Irish in 3D world: Engaging primary school children. *Language Learning & Technology, 20*(1), 21-33.

De Grove, F., Van Looy, J., & Mechant, P. (2013). Learning to Play, Playing to Learn: Comparing the Experiences of Adult Foreign Language Learners with Off-the-

Shelf and Specialized Games for Learning German. *International Journal of Game-Based Learning (IJGBL)*, *3*(2), 22-35.

Douglas Fir Group. (2016). A transdisciplinary framework for SLA in a multilingual world. *The Modern Language Journal*, *100*(S1), 19-47.

Dourda, K., Bratitsis, T., Griva, E., & Papadopoulou, P. (2014). Content and language integrated learning through an online game in primary school: A case study. *Electronic Journal of e-Learning*, *12*(3), 243-258.

Egenfeldt-Nielsen, S. (2007). *Beyond edutainment: The educational potential of computer games.* Continuum Press.

Franciosi, S. J., Yagi, J., Tomoshige, Y., & Ye, S. (2016). The effect of a simple simulation game on long-term vocabulary retention. *CALICO Journal*, *33*(3), 355-379.

Gee, J. P. (2007). *Good video games and good learning: Collected essays on video games, learning, and literacy.* Peter Lang International Academic Publishers.

Gibson, J. (1979). *The ecological approach to visual perception*. Lawrence Erlbaum.

Guan, C. Q., Liu, Y., Chan, D. H. L., Ye, F., & Perfetti, C. A. (2011). Writing strengthens orthography and alphabetic-coding strengthens phonology in learning to read Chinese. *Journal of Educational Psychology*, *103*(3), 509-522.

Hitosugi, C. I., Schmidt, M., & Hayashi, K. (2014). Digital game-based learning (DGBL) in the L2 classroom: The impact of the UN's off-the-shelf videogame, Food Force, on learner affect and vocabulary retention. *CALICO Journal*, *31*(1), 19-39.

Hong, W. (1997). Multimedia computer-assisted reading in business Chinese. *Foreign Language Annals*, 30(3), 335-344.

Horst, M. (2005). Learning L2 vocabulary through extensive reading: A measurement study. *Canadian Modern Language Review*, *61*(3), 355-382.

Hsiao, I. Y. T., Lan, Y.-J., & Kao C.-L., & Li, P. (2017). Visualization analytics for second language vocabulary learning in virtual worlds. *Educational Technology & Society*, 20 (2), 161–175.

Hubbard, P. (1991). Evaluating computer games for language learning. *Simulation & Gaming*, *22*(2), 220-223.

Huckin, T., & Coady, J. (1999). Incidental vocabulary acquisition in a second language. *Studies in Second Language Acquisition*, *21*(2), 181-193.

Hsu, H. Y., & Wang, S. K. (2010). Using gaming literacies to cultivate new literacies. *Simulation & Gaming*, *41*(3), 400-417.

Ibrahim, K. (2017). The impact of ecological factors on game-based L2 practice and learning. *Foreign Language Annals*, *50*(3), 533-546.

Jin, L. (2018). Digital affordances on WeChat: Learning Chinese as a second language. *Computer Assisted Language Learning*, *31*(1-2), 27-52.

Kramsch, C. (2003) Identity, role and voice in cross-cultural (mis)communication. In J. House, G. Kasper, & S. Ross (Eds.), Misunderstandings in *Social life: Discourse approaches to problematic Talk* (pp. 129-153). Longman.

Kramsch, C., & Steffensen, S. V. (2008). Ecological perspectives on second language acquisition and socialization. *Encyclopedia of language and education*, *8*, 17-28.

Krashen, S. D. (2004). *The power of reading: Insights from the research: Insights from the research*. ABC-CLIO.

Lan, Y. J., Fang, S. Y., Legault, J., & Li, P. (2015). Second language acquisition of Mandarin Chinese vocabulary: Context of learning effects. *Educational Technology Research and Development, 63*(5), 671-690.

Lim, C. P. (2008). Global citizenship education, school curriculum and games: Learning Mathematics, English and Science as a global citizen. *Computers & Education, 51*(3), 1073-1093.

Liu, Q., & Chao, C. C. (2018). CALL from an ecological perspective: How a teacher perceives affordance and fosters learner agency in a technology-mediated language classroom. *ReCALL, 30*(1), 68-87.

Long, M. (1997). *Focus on form in task-based teaching*. McGraw Hill. https://woucentral.weebly.com/uploads/7/4/6/9/7469707/long_1997_intro_focus_on_form.pdf

McGraw, I., Yoshimoto, B., & Seneff, S. (2009). Speech-enabled card games for incidental vocabulary acquisition in a foreign language. *Speech Communication, 51*(10), 1006-1023.

McHugh, M. L. (2012). Interrater reliability: the kappa statistic. *Biochemia Medica, 22*(3), 276-282.

Müller, A. (2012). Improving the identification of medication names by increasing phonological awareness via a language-teaching computer game (Medicina). In S. Arnab, I. Dunwell & K. Debattista (Eds.), *Serious games for healthcare: Applications and implications* (pp. 283-295). ICI Global.

Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice*. Sage.

Peterson, M. (2011). Digital gaming and second language development: Japanese learners interactions in a MMORPG. *Digital Culture & Educ*ation, *3*(1), 56-73.

Pigada, M., & Schmitt, N. (2006). Vocabulary acquisition from extensive reading: A case study. *Reading in a Foreign Language,* 18(1), 1-28.

Peng, W., Song, H., Kim, J., & Day, T. (2016). The influence of task demand and social categorization diversity on performance and enjoyment in a language learning game. *Computers & Education, 95*, 285-295.

Poole, F. J. (2020). *Developing and validating stealth assessments for an educational game to assess young dual language immersion learners' reading comprehensi*on. All Graduate Theses and Dissertations. https://digitalcommons.usu.edu/etd/7900

Poole, F., Clarke-Midura, J., Sun, C., & Lam, K. (2019). Exploring the pedagogical affordances of a collaborative board game in a dual language immersion classroom. *Foreign Language Annals, 52*(4), 753-775.

Poole, F., Franco, J., & Clarke-Midura, J. (2018). Developing a personalized, educational gaming experience for young Chinese DLI learners: A design-based approach. In R. Zheng (Ed.), *Digital technologies and instructional design for personalized learning* (pp. 253-274). IGI Global

Poole, F., & Sung, K. (2015). Three approaches to beginning Chinese instruction and their effects on oral development and character recognition. *Eurasian Journal of Applied Linguistics, 1*(1), 59-75.

Poole, F., & Sung, K. (2016). A preliminary study on the effects of an E-gloss tool on incidental vocabulary learning when reading Chinese as a foreign language. *Journal of Chinese Language Teachers Association*. 51(3), 266–285.

Rama, P. S., Black, R. W., Van Es, E., & Warschauer, M. (2012). Affordances for second language learning in World of Warcraft. *ReCALL. 24*(3), 322.

Saldaña, J. (2015). *The coding manual for qualitative researchers*. Sage.

Shen, H. (2013). Chinese L2 literacy development: Cognitive characteristics, learning strategies, and pedagogical interventions. *Language and Linguistics Compass, 7*(7), 371-387.

Shen, H., & Tsai, C. H. (2010). A web-based extensive reading program and its assessment system. *Journal of the Chinese Language Teachers Association.* 4*5*(2), 19-47.

Shen, H. H., Zhou, Y., & Gao, G. (2020). Oral Reading Miscues and Reading Comprehension by Chinese L2 Learners. *Reading in a Foreign Language, 32*(2). 143-168.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research techniques*. Sage.

Suh, S., Kim, S. W., & Kim, N. J. (2010). Effectiveness of MMORPG-based instruction in elementary English education in Korea. *Journal of Computer Assisted Learning, 26*(5), 370-378.

The R Foundation. (2017) *R: A language and environment for statistical computing*. https://www.R-project.org/

Thoms, J. J. (2014). An ecological view of whole-class discussions in a second language literature classroom: Teacher reformulations as affordances for learning. *The Modern Language Journal, 98*(3), 724-741.

Thoms, J. J., & Poole, F. (2017). Investigating linguistic, literary, and social affordances of L2 collaborative reading. *Language Learning & Technology, 21*(2), 139-156.

Thorne, S. L., Fischer, I., & Lu, X. (2012). The semiotic ecology and linguistic complexity of an online game world. *ReCALL*. 3, 279-301.

van Lier, L. (2004). *The ecology and semiotics of language learning: A sociocultural perspective*. Kluwer Academic Publishers.

Wang, J. (2009). Electronic strategies to improve Chinese reading skills. In R. D. C. V. Marriott & P. L. Torres (Eds). *Handbook of research on e-learning methodologies for language acquisition* (pp. 237-252). Information Science Reference.

Wang, J., & Upton, T. (2012). The impact of using a pop-up dictionary on the reading process of beginning learners of Chinese. *Journal of Chinese Language Teachers Association, 41*(1), 23-41.

Watzinger-Tharp, J., Rubio, F., & Tharp, D. S. (2018). Linguistic performance of dual language immersion students. *Foreign Language Annals, 51*(3), 575-595.

Wu, T. T., & Huang, Y. M. (2017). A Mobile Game-Based English Vocabulary Practice System Based on Portfolio Analysis. *Journal of Educational Technology & Society*, 20(2), 265-277.

Xie, T., & Yao, T. (2009). Technology in Chinese language teaching and learning. In M. Everson & Y. Xiao (Eds.), *Teaching Chinese as a foreign language* (pp. 151-172). Cheng & Tsui.

Xu, Y., Chang, L. Y., Zhang, J., & Perfetti, C. A. (2013). Reading, writing, and animation in character learning in Chinese as a foreign language. *Foreign Language Annals, 46*(3), 423-444.

Yudintseva, A. (2015). Synthesis of research on video games for the four second language skills and vocabulary practice. *Open Journal of Social Sciences*, *3,* 81-98.

York, J. (2020). Pedagogical considerations for teaching with games: Improving oral proficiency with self-transcription, task repetition, and online video analysis. *Ludic Language Pedagogy,* (2), 225-255.

York, J., Poole, F. J., & DeHaan, J. W. (2021). Playing a new game—An argument for a teacher-focused field around games and play in language education. *Foreign Language Annals, 54*(4), 1164-1188.

Zheng, D., Newgarden, K, & Young, M.F. (2012). Multimodal analysis of language learning in World of Warcraft play: Languaging as values-realizing. *ReCALL*, *24*(3), 339-360.

