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Lost in the Middle Kingdom: Teaching New Languages Using Serious Games and Language Learning Methodologies

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LOST IN THE MIDDLE KINGDOM: TEACHING NEW LANGUAGES USING SERIOUS
GAMES AND LANGUAGE LEARNING METHODOLOGIES

by

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ABSTRACT

This thesis focuses on the design and development of a serious video game for language learning entitled *Lost in the Middle Kingdom*. Our game utilizes several language learning methodologies including second language acquisition theory, content-based instruction, and task-based language teaching. This thesis examines previous language learning games and their drawbacks in order to create a more effective experience. *Lost in the Middle Kingdom* seeks to balance language learning with fun and intuitive gameplay in order to deliver a form of interactive media that is accepted by both the gaming and research communities. Our test data illustrates the strengths and weaknesses of our game and how future improvements can bolster its effectiveness.

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LIST OF ABBREVIATIONS

AI .... ARTIFICIAL INTELLIGENCE

CALL .... COMPUTER ASSISTED LANGUAGE LEARNING

CBI .... CONTENT-BASED INSTRUCTION

GUI .... GRAPHICAL USER INTERFACE

LAD .... LANGUAGE ACQUISITION DEVICE

NPC .... NON-PLAYER CHARACTER

SLA .... SECOND-LANGUAGE ACQUISITION

TBLT .... TASK-BASED LANGUAGE TEACHING

CHAPTER 1

INTRODUCTION

1.1 VIDEO GAMES

Video games are an expanding part of our world; they provide entertainment, competition, and a means to measure one's skill. They serve as an important part of many lives and societies. Players devote countless hours to playing video games while taking the role of many characters and exploring new worlds. Their multi-disciplinary nature requires work in art, sound, design, and technology, making them a unique form of digital media. The video game market is worth billions, generating new content that pushes the limitations of new hardware and the imaginations of both game designers and players. Interest in video games has grown immensely thanks to their impact on culture and its players.

1.2 GAMING IN EDUCATION

Due to the popularity of video games, there is widespread interest in the potential educational value of a video game. Various groups including teachers, game designers, and researchers have asked themselves how they can use this form of media to aid in the learning process. These type of educational games, known as serious games, aim to convey information while also entertaining the user [17]. They are promoted for their ability to engage the learner [18]. Serious games focusing on areas of science, math,

history, foreign languages, typing, and other subjects appeared as early as the 1970s with the introduction of personal computer systems like the Altair 8800, Apple II, and Commodore 64. These systems all had educational games in their software lineup. Due to their low-stress nature, educational video games can help reduce tension and anxiety in learners [1]. Video games can motivate learners and adjust to their level of knowledge and skill. With interactive virtual worlds, players can practice the subject material in realistic situations and settings. The nature of video games encourage players to explore and experiment with their surroundings. The process of game playing is engaging [10].

Interest in video game-based learning from researchers have led to various studies involving the learning of a second/foreign language using video games. The adventure genre in particular is believed to be very beneficial to language learning by several researchers and game-based learning professionals [21]. Adventure games allow the player to take on multiple roles depending on the game, allowing for contextual learning. A study conducted by Yang and Chen [21] studied 60 students playing a commercial video game to learn English as a second language. On a five-point Likert scale, students believed that playing an adventure video game enhanced their learning motivation with an average score of 4.12. Participants liked the game because they were able to learn new words and common phrases in an English environment.

1.3 RELATED WORK

With the use of computer-assisted language learning (CALL) [9] systems and the popularity of video games, game designers have tried to balance language learning and gameplay in order to create novel ways of teaching languages. Traditional classroom

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methods of language teaching such as drills and dialogue exercises have proven to be effective [4], but can sometimes be tedious and difficult [16]. By conducting research and development into interactive technologies, an intuitive and inviting video game can be developed and enjoyed by many. Before explaining the design of our game, *Lost in the Middle Kingdom*, it is important to analyze the pros and cons of some existing language learning video games to improve the implementation of ours.

According to Egenfeldt-Nielsen [3], many existing language learning games share problematic assumptions about motivation including:

- *Little intrinsic motivation:* Some games reward players with trophies or points – this is an example of extrinsic motivation. The feeling of mastering a level would be an example of intrinsic motivation.

- *No integrated learning experience:* These games typically fail to balance the learning experience with gameplay. This may lead to players skipping through educational portions of the game in order to quickly play mini-games which may or may not include educational content.

- *Simple gameplay:* These games sometimes involve simplistic gameplay such as moving around to collect on-screen objects; these titles typically do not show innovation.

- *Drill-and-practice learning principles:* Educational portions of these games are modeled after language drills rather than meaning and comprehension. This results in players memorizing answers to questions, rather than understanding the meaning of the educational content being taught.

Low budgets help bring about mediocre content in a large number of language learning games [13]. The people buying these types of games typically aren't the ones using them, often a parent purchasing a title for their child to play in hopes that they will learn [3]. These shortcomings have led to negative attitudes toward educational games.

1.3.1 LEONARDO'S LANGUAGE BRIDGE

Leonardo's Language Bridge [7] is a language learning video game developed by Ohio Distinctive Software. This game's child-friendly bear mascot character takes the player through multiple quizzes which are may seem tedious and uninteresting, before rewarding the player with a short driving sequence game. This type of structure is something that Egenfeldt-Nielsen [3] warns against. Players may skip through the quiz portion in order to reach the driving minigame, resulting in a failure to learn the educational content. The game failed to offer much of a cultural component despite being offered in 4 different languages: Spanish, Italian, French, and German. The game was generic; each language version featured the same simplistic gameplay and menus; the only difference was the language. This eliminated any chance of having a cultural connection, something Egenfeldt-Nielsen [3] suggests. The driving sequence failed to incorporate much of the target language in addition to having boring gameplay and no story.

Figure 1.1: Leonardo's Language Bridge. An in-game quiz is seen on the left, while the right shows the driving sequence minigame.

1.3.2 TACTICAL IRAQI

Tactical Iraqi [19] was developed by the United States military to teach military personnel how to speak Iraqi-style Arabic. The game features multiple modes, language options, as well as voice-recognition. *Tactical Iraqi* manages to hold the player's attention thanks to its gameplay and use of familiar third-person style controls. The player explores a 3D virtual representation of the Middle East complete with stores, streets, homes, and other infrastructure. Players can interact with various in-game objects such as NPCs (non-player characters), photographs, and cups of tea.

Figure 1.2: Tactical Iraqi gameplay. Here, a soldier avatar interacts with an NPC civilian.

The game engages the player in multiple missions using an avatar. In one situation, an NPC leads multiple soldiers into a café in hopes to acquire important information. The game uses AI (artificial intelligence) and voice recognition to help change the game in real-time [8][19]. For example, a negative reaction will occur if American soldiers refuse to show respect or give a proper greeting when entering the virtual café. In other missions, learners must speak with various Iraqi citizens in order to complete a task. During arcade mode, the avatar receives spoken commands from the player in order to complete an objective.

An independent evaluation of Tactical Iraqi was conducted by the United States military and reported in Surface and Dierdorff [18]. Test groups trained for 40 hours using Tactical Iraqi exclusively or a mixture of Tactical Iraqi and classroom instruction. Both groups showed significant gains in knowledge of the Arabic language and culture, with the group using Tactical Iraqi exclusively showing the best gain, with six out of eight participants achieving an ILR (Interagency Language Roundtable) level of 0+. Several traits of a level 0+ speaker include: comprehension of multiple memorized phrases in areas of immediate needs; phrases understood are typically short in length; can recognize the letters of an alphabetic system; capable of reading some or all numbers, isolated words, and phrases [5]. Speech attempts using the system's speech recognizer were correct 65% of the time, while average quiz scores were 70% [18]. Participants felt more motivated and positive toward learning the language, making for more affective learning.

Tactical Iraqi is used by military personnel, not everyday civilians. Tactical Iraqi shows positive results in teaching learners a language, but It only presents situations

common to soldiers in the Middle East, making it less useful for everyday civilians. Because a reward system is absent, players are motivated not by the game or story, but by its goal of teaching Arabic to soldiers who will likely use the knowledge in foreign scenarios.

1.3.3 THE NEED FOR LANGUAGE GAMES

It can be argued that there still isn't a mainstream language learning video game that has been accepted by both the gaming and research community. This could be due to the negative attitude towards educational games by the gaming community, which could make game developers decide against creating educational games. As cited in the 2010 National Education Technology Plan. U.S. Secretary of Education Arne Duncan calls for "research and development that explores how embedded assessment technologies, such as simulations, collaboration environments, virtual worlds, games, and cognitive tutors, can be used to engage and motivate learners while assessing complex skills [20]." The report highlights video games, stating "Interactive technologies, especially games, provide immediate performance feedback so that players always know how they are doing. As a result, they are highly engaging to students and have the potential to motivate students to learn [20]." It asks for research collaboration between assessment and interactive technology experts to create ways to use video games effectively for assessment.

Improvements in technology, new language learning techniques, and the increased use and desire to use interactive technology in classrooms have resulted in a need for an effective and engaging language learning game. Video games can act as

training tools, just like lectures, group discussions, and textbooks [18] commonly found in classroom settings. They can act as a replacement for traditional teaching methods, or as a way to augment the learning experience. It is important to note that creating a game that pleases every player would be difficult. Our primary goal is to create a fun and inviting way to teach basic Chinese to the player while simultaneously having fun with the game's puzzles, minigames, and atmosphere. By balancing language learning with game design, we hope to implement a game that can be enjoyed by players of all ages and types. Video games are neither effective or ineffective in and of themselves if the design is fundamentally sound; the success or failure lies with the use of the video game [18].

CHAPTER 2

BACKGROUND

2.1 LOST IN THE MIDDLE KINGDOM

Our game, *Lost in the Middle Kingdom*, hopes to deliver an experience unlike any other language learning video game in existence. By incorporating several key points essential to building an effective language learning game outlined in Purushotma [13], we hope to avoid common drawbacks of previous language learning games outlined by Egenfeldt-Nielsen [3]. The key points we focused on include:

- Instruction needs to ensure that learners focus predominantly on meaning.

- All elements of the game, particularly communication and input mechanisms, should have a playful spirit to them.

- Learning content should be organized around tasks.

- New concepts should be introduced gradually and interspersed with other content before requiring difficult responses from players.

- Assessment should intelligently track free production tasks throughout the game, not simply measure controlled production during test events.

Lost in the Middle Kingdom contains an immersive 3D environment ready for exploration, an overarching story, intuitive controls and gameplay, as well as cultural elements. By incorporating real-world situations throughout the game, players are

presented with multiple opportunities to practice the target language in realistic situations [1]. This will hopefully boost a learner's confidence in using the language in a real-world setting.

2.2 SECOND LANGUAGE ACQUISITION

Second language acquisition theory (SLA) is a method where the learner is immersed in the target language in order to give them an intuitive feel for it [14]. The learner is introduced to the language in a stable order of acquisition; the learner sees simple, comprehensible input initially, but is later presented with more difficult information. By gradually introducing new mechanics and information, players may feel a sense of progression. Because players build upon previous learned knowledge, they may be more willing to explore and experiment with new information and puzzles if there confidence level is high [15]. Stephen Krashen, a linguist from The University of Southern California, suggests that a second language is best acquired when the learner focuses on meaning rather than syntax and form [15]. By engaging learners in meaningful, low-stress situations, students will pick up the language in a natural way.

According to Krashen, three factors contribute heavily to how well a learner acquires a language: motivation, confidence, and anxiety. Learners with low anxiety and a high level of motivation and confidence will have a better chance of success in second language acquisition. Learners with low motivation and high anxiety can sometimes result in a mental barrier that inhibits second language acquisition.

Lost in the Middle Kingdom presents the player with multiple levels and difficulties. Initially, the player will encounter simple Chinese content. As they explore

newer levels, they will be presented with more difficult learning material that is step above their current level of knowledge. To put It simply, the game's levels are arranged from easy to hard in terms of Chinese content.
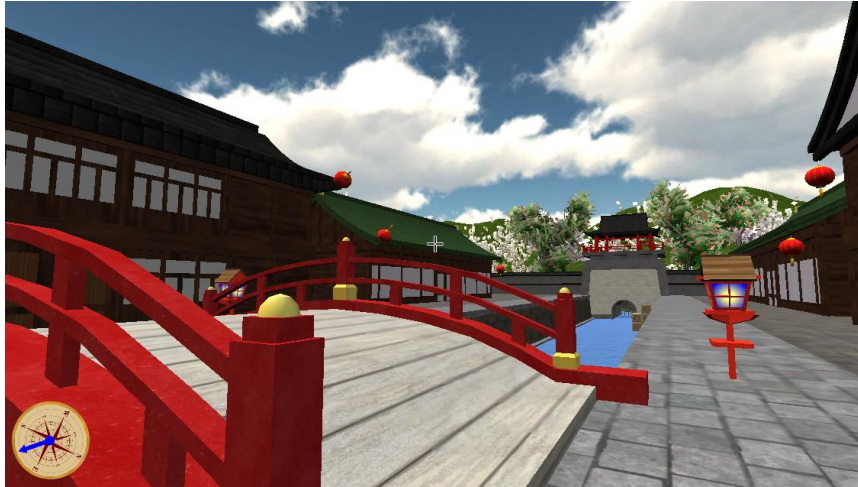

Figure 2.1: *Lost in the Middle Kingdom* environment. 3D environments are used to immerse the player in a virtual representation of China.

2.3 TASK-BASED LANGUAGE TEACHING

Task-based language teaching (TBLT) incorporates the use of tasks to teach the target language. A task is an activity or action that requires the player to comprehend, use, or produce the target language in order to complete [6]. Examples of tasks include solving a puzzle, talking with other characters, reading a map, listening to an audio tape, and writing a letter.

In order to complete *Lost in the Middle Kingdom'*s various levels, players must complete a multitude of tasks that require the use of the Chinese language. In one situation, the player is required to place a specific number of apples inside a basket. The player must use any item or clue at their disposal in order to help them complete this task. This may include using items to search for apples, or using an abacus in order to figure

out the specific number of apples required. Once the task is complete, a door will open, allowing the player access to the next portion of the level. These type of tasks are crafted in a way that allow the player to experiment with possible solutions without fear of negative consequences.

Another type of task requires the player to speak to NPCs. Certain NPCs will ask the player for an object. For example, a gardener may ask the player, "Will you please bring me some water?" in Chinese; the player must dissect the sentence in a GUI-based minigame in order to understand its meaning. By using context clues and acquired information from previous tasks and levels, the player will hopefully understand the sentence and bring the NPC water. This minigame is explained in detail in the next chapter.

2.4 CONTENT-BASED INSTRUCTION

Content-Based Instruction (CBI) is a method where the learner focuses on a specific subject [2]. It is useful to sequence concepts commonly found in traditional classroom curriculums [13]. By focusing on a specific subject, the learner will acquire language pertaining to it. The heavy use of diagrams, images, and maps help the learner during CBI. Subject material presented must be seen as "important, relevant, and useful" by learners [2]. This can motivate learners and promote language acquisition. For example, if a learner is watching a Chinese film about basketball, they will likely learn vocabulary pertaining to basketball.

CBI is used heavily in *Lost in the Middle Kingdom*. Each of the game's levels aim to teach knowledge about a specific subject such as greetings, numbers, and

transportation. Additionally, "knowledge items" are obtained by the player in order to

learn new knowledge about a specific item. For example, a calendar is given to the

player that they may open and read in order to learn new information about dates.

Knowledge items are discussed further in Chapter 3.

CHAPTER 3

GAME DESIGN

3.1 DESIGN OVERVIEW

Lost in the Middle Kingdom is an educational adventure game with puzzle

elements. The game is totally immersive, using a 3D world to place the player in a

virtual representation of China, a major cultural component of the game. The player is

presented with multiple pieces of information that you would typically see in a classroom

or textbook designed to teach Chinese including: hanzi (Chinese characters), pinyin

(Romanized spelling for Chinese), pronunciation, picture associations, and vocabulary.

These pieces of information can be found by examining the many objects found

throughout the game. Players complete simple tasks and puzzles in order to progress

throughout the game; this an example of incorporating TBLT. It presents the player with

multiple levels as well as inventory items that focus on a specific topic; this is an example

of how the game uses CBI. This design helps us in our goals for the player:

- Smooth player interactions

- Augmenting vocabulary

- Promoting proper pronunciation

- Memorization.

Because it is important to sequence concepts commonly found in classroom

curriculums [13], each of our game's levels focus on a specific subject derived from the

textbook *Integrated Chinese*: *Simplified Character Edition Level 1 Part 1* [22]. The

levels focus on numbers, greetings, dates and time, family, shopping, hobbies, school life,

making appointments, visiting friends, weather, and transportation. Many of the words

and phrases found in the textbook are used within the game. While each level focuses on

a different subject, the player will find that certain words and puzzles of previous levels

are incorporated into successive levels, building off the player's acquired knowledge and

skills. By taking this approach, we hope players will feel more comfortable when

encountering puzzles that require both new and old words.

3.2 GAMEPLAY OVERVIEW

Players begin the game in the virtual overworld. The overworld is the primary

area of the game that interconnects various levels presented throughout the game. The

overworld is surrounded by large walls that have multiple locked gates. Beyond the gates

are portals that teleport the player to various levels. The focal point of the overworld is a

large oriental style temple, situated at the front of the overworld. All gates are locked

initially; the player is only able to explore the overworld freely and enter the temple.

Figure 3.1: Wall View of the Overworld.

When the player enters the temple for the first time, an in-game cutscene will occur. The purpose of this cutscene is to illustrate the overarching story of the game. The major obstacle in developing the story for *Lost in the Middle Kingdom* was the inability to use the player's primary language to tell the story. This lead to the heavy use of 3D models, imagery, visual effects, and animation to convey the story.

Figure 3.2: Initial Cutscene. The use of effects, sound, lighting, and character design help create the mood for the opening cutscene.

During the opening cutscene, the player loses the ability to control themselves, letting them know they are in a cinematic state and the ensuing events are out of their control. While the game controls the player's movement, the player will notice several scrolls floating atop multiple pedestals. After a short while, a masked character appears, walks up to the player, and creates a circle of flames around them; this lets the player know this mysterious character is a malicious enemy. The enemy continues to walk towards the center of the temple and steals the scrolls, after which a flash of light blinds the player momentarily. The player regains their vision shortly after and notices that the enemy and scrolls are gone. The flames dissipate and the player is able to control their character

again. The player's only options from here are to explore and leave the temple. Once the player leaves, they will notice a sparkling key at the base of the temple stairs. Once the player acquires the key, a GUI image will appear in the top-right corner of the screen, showing the player that they have collected a key. The player continues to explore the overworld, searching for an entrance to unlock. While exploring, they will notice that the overworld's surrounding walls contains multiple gates with a large lock containing a keyhole in the front. The player will intuitively know that the key they just acquired will unlock one of these twelve gates. Outside each gate is a sign with a Chinese character written on it. These characters represent a level number from 0 to 11. At this point, there are two strategies the player can take to find the proper gate:

- Trial and Error – the player attempts to unlock each door until one opens.
- Intuition – the player may intuitively understand 3 of the 12 signs. The 3 Chinese characters the player may intuitively understand due to the placement and number of strokes are 一 , 二 , and 三 which represent 1, 2, and 3 respectively. The player may also notice that these signs appear in sequence with gate 1 appearing first, followed by gates 2 and 3. At this point the player may try to open gate 1, which will remain locked. From here, the player may investigate the east wall further and notice that there is a gate that appears before gate 1 along the east wall. This gate contains the symbol for 0, 零, which will look unfamiliar to the player. However, if the player was able to intuitively understand the symbols for 1, 2, and 3, they may guess that the unfamiliar sign means 0. If the player tries to unlock this gate, it will open and allow the player to begin playing Level 0 which acts as a tutorial level to teach the player basic controls, gameplay, and other mechanics.
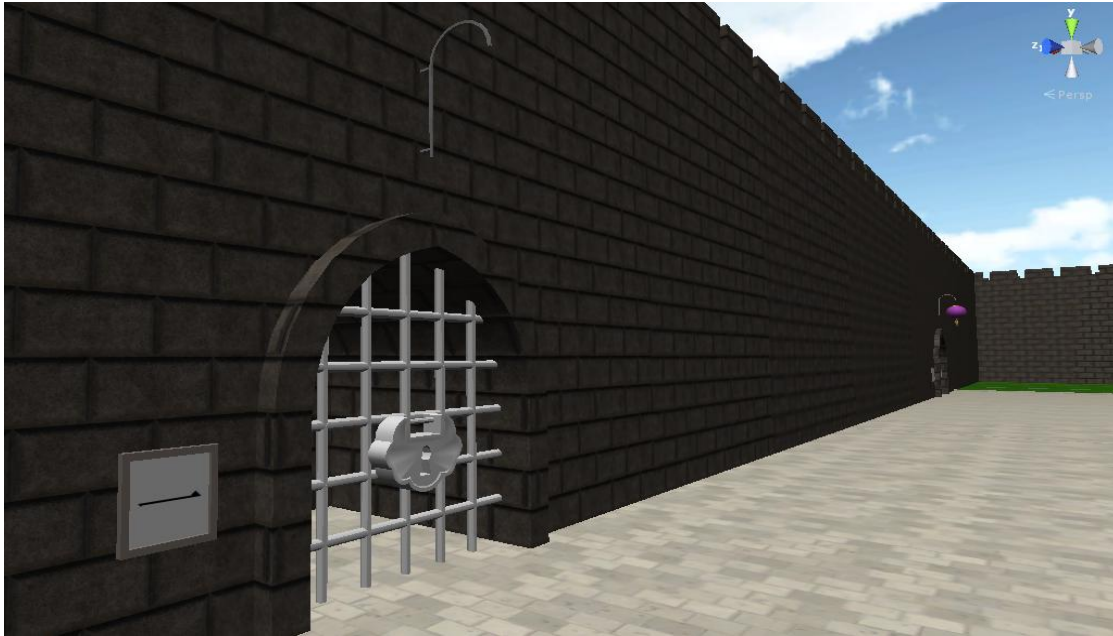
Figure 3.3: Level 1 gate. The purple object in the background is a lantern; these appear above the gate whenever the player completes that specific level.

With the stolen scrolls acting as the overarching story element, the player must retrieve a single scroll from each level and return them to their rightful place in the temple.

3.2.1 INTERACTIONS

Lost in the Middle Kingdom uses common first-person style controls where players take the role of the protagonist. This control scheme uses the W, S, A, and D keys for forward, backward, left, and right movement respectively. The player is able to look around the environment by using the mouse. The player can pause the game by pressing the "E" key; this button was selected due to its close proximity to the W, S, A, and D keys. Pausing the game also brings up the inventory menu from which the player can select different items to use for fighting enemies or solving puzzles. The "interact" key is represented by the "F" key and is used with certain objects in order to execute a specific action. An on-screen image of the "F" key is displayed whenever the player is

capable of executing one of these specific actions. An example of this would be opening a door or speaking with an NPC. The player is also given the ability to pick up and drop items. Players can pick up items with a right-click of the mouse; they can drop the held object by right-clicking again. The spacebar is used for jumping.

3.2.2 COMBAT

Throughout *Lost in the Middle Kingdom* the player will encounter multiple enemies. Enemies are malicious NPC characters that attack the player. Once the player has acquired a weapon, they can use it to engage and defeat enemies in order to proceed further into the level. Weapons are described in detail within Sections 3.3.6-3.3.9.

Enemies attack the player in a variety of methods, ranging from sword attacks to magical flames. While most video games utilize a health meter for the player that depletes when damaged by an enemy, *Lost in the Middle Kingdom* utilizes a "corruption" system as an alternative. With this system, an entry in the player's digital library known as the Chinadex will have its picture representation removed when an enemy inflicts damage upon the player (the Chinadex is explained in detail in Section 3.3.2).

Figure 3.4: Enemy Damage. The center image acts as a visual and audio cue to let the player know that an entry in their Chinadex has become corrupted.

The missing picture representation will be replaced by a large red 'X', which symbolizes corruption. A rectangular button with a screwdriver image will also appear in the Chinadex menu, enabling the player to "fix" their digital library. By pressing this 'uncorrupt' button, the player will be sent to a matching minigame in which they must match the corrupted word with one of four picture representations. This corruption alternative was implemented to eliminate the need to kill the player and reset them at a checkpoint, something that may demotivate or frustrate them, especially in combat-heavy scenarios like boss fights.

3.3 INVENTORY ITEMS

As the player progresses throughout the game, they will acquire new items to add to their inventory. These items will help the player complete tasks, solve puzzles, and fight enemies. Inventory items are divided into two groups: knowledge items and weapons. Knowledge items are objects the player can use to acquire knowledge about a

specific subject; they can be used at any time once acquired. Weapons are primarily used to fight enemies but can also be used to solve puzzles. Weapons are also available for use at any time once obtained.

Figure 3.5: Inventory and Backpack Menu.

3.3.1 COMPASS

The compass is the first item acquired by the player. This item acts as a tool to help point the player towards their next goal. Once collected, a compass image will appear on-screen; this image will rotate depending on the direction the player is facing. The compass will display a bright blue arrow which points towards the location of the next objective. This is very helpful since the game does not communicate with the player using their primary language; this will help decrease the amount of players asking themselves questions like "Where do I go next?" and "What do I do now?". Once the player reaches the objective area, the blue arrow will disappear. This will let the player know they are in the proper area and must begin exploring their surroundings in order to complete the next task.

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3.3.2 KNOWLEDGE ITEM – CHINADEX

The player acquires a digital library known as the "Chinadex" within the first level of the game. This is the game's most important item. The Chinadex was modeled after the 'Pokedex', a familiar item used in the popular video game franchise *Pokémon* [12]. In *Pokémon*, the player is given a Pokedex in order to obtain new information about various Pokémon, creatures that inhabit the different regions presented in *Pokémon* games. By scanning or capturing different Pokémon, the player acquires new data and builds their Pokedex, acting as an encyclopedia of knowledge. Our Chinadex acts in a similar manner. By left-clicking the mouse, players can "scan" the environment and its objects in order to collect its data. After scanning an object players are presented with hanzi, pinyin, and a picture representation to help explain what the object is. The hanzi is shown with different colored backgrounds; over time, the player will intuitively understand that the colors represent parts-of-speech (e.g. nouns have a yellow background while verbs have a green background). The user is also presented with a pronunciation button. By pressing this button, the player will hear the proper pronunciation of a word recorded by a native Chinese speaker. By scanning objects, the player slowly builds their digital library which stores this information. This library can be accessed at any time in order to help the player memorize information, or complete in-game tasks.
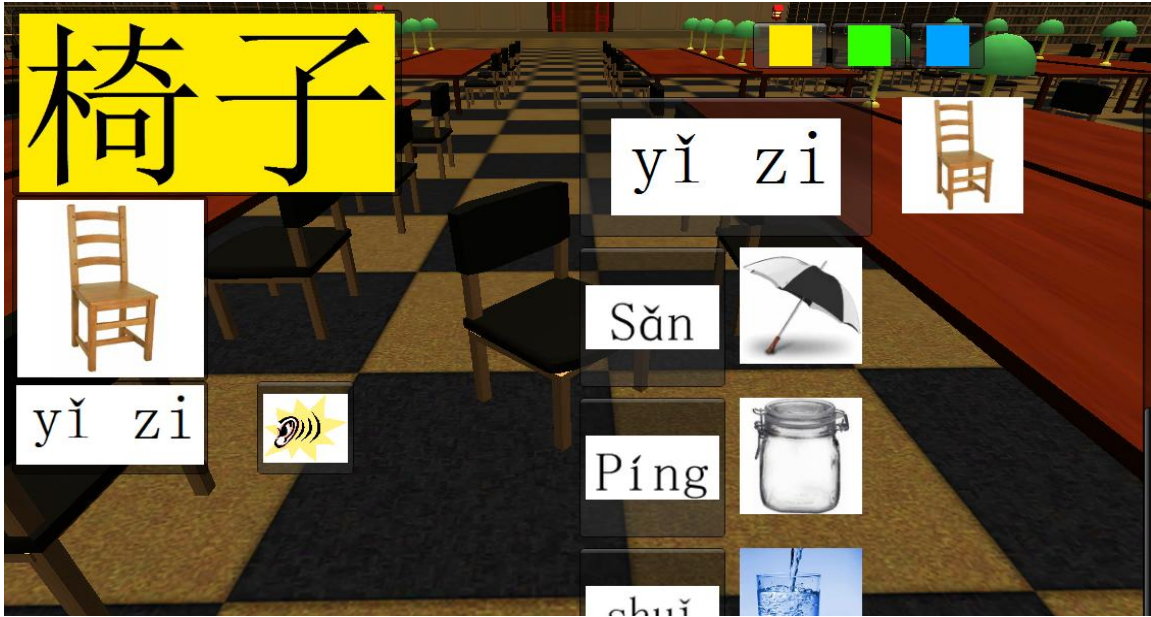
Figure 3.6: Chinadex. The Chinadex screen after scanning a chair.

3.3.3 KNOWLEDGE ITEM – ABACUS

An abacus is a tool containing a frame and several rows of wires which contain multiple beads; it is used for calculations. The player acquires this item inside Level 1 which focuses on teaching numbers. By using this tool, the player will acquire knowledge about numbers, helping them complete tasks or puzzles that require knowledge of numbers.

By opening the inventory menu and pressing the abacus button, illustrated by a picture of the tool, an interactive menu will appear that acts as the abacus. From here, the player is able to cycle through numbers 0 -100 in sequence in order to learn their hanzi and pinyin. Each number's hanzi is placed on a button that enunciates the number when clicked. Next to the pinyin is a picture representation that shows multiple apples. The number of apples in the picture illustrates the number's amount. For example, an image containing 10 apples would tell the player that the current number they are viewing is 10.
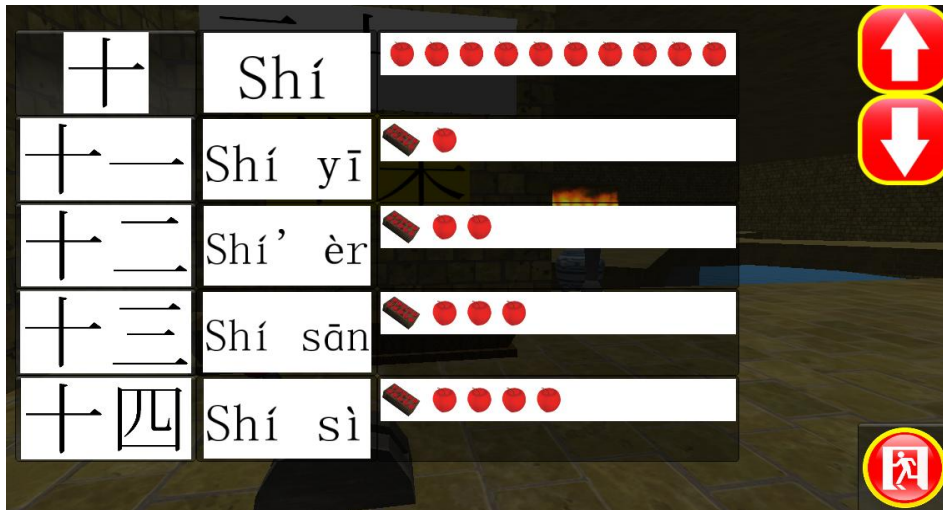
Figure 3.7: Abacus. The player using the abacus to acquire knowledge about numbers.

3.3.4 KNOWLEDGE ITEM – CALENDAR

The calendar is obtained in Level 3 which focuses on dates and time. This is another example of CBI. By reading the calendar, the player will acquire knowledge about dates. By selecting the calendar button in the inventory menu, an interactive menu will appear that contains an image illustrating a month or day, as well as left and right arrow buttons that allow the player to cycle through the twelve months of the year followed by the seven days of the week. The image contains a circled character representation which tells the month or day. By cycling through the calendar, the player can intuitively understand the months and days by seeing that the circled characters are in numerical order, just like any other calendar.

Figure 3.8: Calendar Screen.

They may, however, not initially understand the meaning of the last Chinese character

represented in the circled portion, 月, which is the character for "month". By realizing

that this symbol appears after each number in the circled month region, the player can

make an educated guess for its meaning. This knowledge item builds off the players

acquired knowledge of numbers from Level 1.

3.3.5 KNOWLEDGE ITEM – POCKET WATCH

The pocket watch is also obtained within Level 3. The use of a pocket watch is

another example of CBI. By viewing the pocket watch and reading the times, the player

will acquire knowledge pertaining to time. This knowledge item also builds from the

player's knowledge of numbers from Level 1.

An interactive menu will appear when the pocket watch is selected from the

inventory screen. This menu contains a large image depicting a specific time, up and

down arrows, AM and PM buttons, a pinyin button, and a hanzi section. The images

show a specific time with the minute hand colored in black and hour hand in navy blue. By using the up and down arrow buttons, the player can cycle through different times in 15 minute intervals (e.g. 12:00, 12:15, 12:30, 12:45, etc.). The pinyin section doubles as a pronunciation button that enunciates the time when pressed. The AM and PM buttons are illustrated with "morning" and "night" buttons. The morning/AM button shows a sunrise over a valley while the night/PM button shows a moon and starry sky. If pressed, another hanzi and pinyin section will appear, teaching the player the difference between AM and PM. Using the pocket watch can help the player immensely when faced with puzzles and minigames that utilize time.
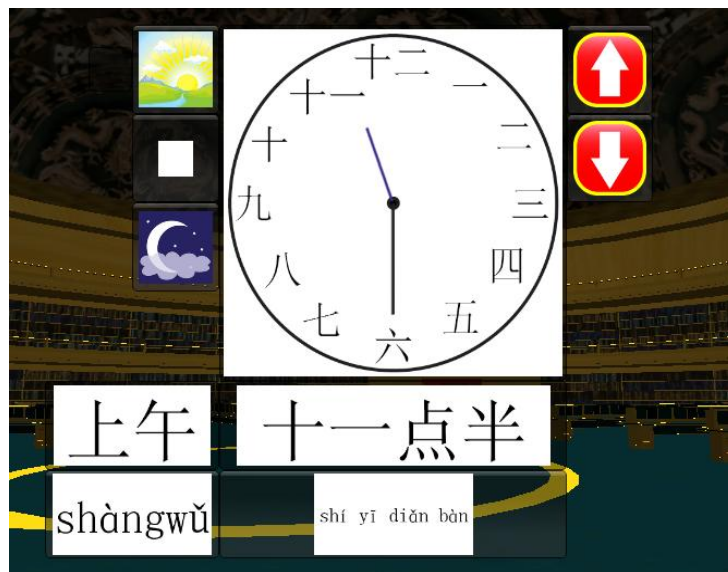

Figure 3.9: Pocket Watch Screen.

3.3.6 WEAPON – BACKPACK

The backpack is obtained within the tutorial level. The backpack gives the player several new ways of interaction and learning. The backpack holds specific items known as "backpack items" which the player collects throughout the game. If a player scans a

backpack item, it will be put into their backpack; that item's data will also be added to the player's Chinadex. If the player opens the backpack menu, they will see a list of every backpack item the player has scanned. The listing shows a picture representation, pinyin button, and a hanzi button for each item. By selecting an item, the player can "pull out" that item and use it. This is a useful tool for puzzles that require the use of specific objects that may not be near the player. Players are able to pull out as many of these backpack items as they want. If a Chinadex entry becomes corrupted by an enemy attack and happens to be a backpack item as well, the player will be unable to retrieve that item from their backpack until they uncorrupt their Chinadex. Uncorrupting the Chinadex requires the player to play a short matching minigame; this reinforces memorization of hanzi, pinyin, and picture representations.

3.3.7 WEAPON – BOW AND ARROW

The bow and arrow is obtained within the tutorial level. This weapon acts as the player's primary weapon against enemy characters. The player is capable of carrying 10 arrows at a time. When the bow is equipped, the game's screen will display an image showing an arrow and number represented in Chinese characters – this shows the player their arrow count. Showing the number in Chinese helps with number memorization and immersion. The player must pay attention to this number in order to know when to look for additional ammo for fighting enemies and solving puzzles that require the use of the bow and arrow.
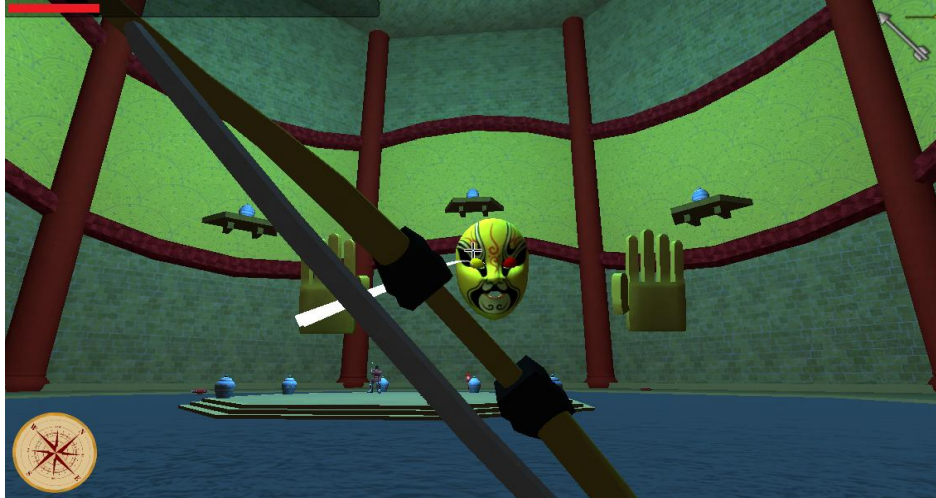
Figure 3.10: Bow and Arrow. The player uses the bow to attack an enemy boss character.

3.3.8 WEAPON – GONG MALLET

The gong mallet is used to hit various gongs found throughout the game. Gongs originated in China, which adds to the cultural component of the game. Hitting a gong with the gong mallet will trigger an event; typical events include:

- Opening doors
- Revealing new environment objects

The gong mallet can also be used to break certain objects such as a jar, which may reveal a secret item.

Figure 3.11: Gong Mallet. The player prepares to hit a gong with the gong mallet.

3.3.9 WEAPON – FIREWORKS

Fireworks are used as another mode of combat against enemies, acting similarly to the bow and arrow. These were also chosen for their cultural and historical connection to China. When equipped, an image containing a picture of a firework and a number represented in Chinese characters illustrating the player's current amount of fireworks will appear on-screen. If the player's firework count reaches zero, they must play a short matching minigame in order to replenish their ammunition.

The player will also encounter a special type of firework known as a "super firework." These weapons only appear during boss fights and cannot be kept in the player's inventory, i.e., they can only have one at a time. Super fireworks are dispersed throughout a boss arena and locked within a steel cage which must be unlocked by the player in order to be used. When standing next to a locked super firework, the player can enter a short matching minigame by pressing the interact key.

Figure 3.12: Launching Fireworks. Notice the icon in the top-right corner displaying the player's remaining firework count in Chinese.

If the player gives an incorrect match, the super firework will disappear without rewarding the player and reappear after fifteen seconds, forcing the player to search for another super firework. A correct match will unlock the cage and reward the player with the super firework, which they must use to fight the boss character. Two types of super fireworks are implemented in the game: standard and homing. Red standard super fireworks rely on the player's aiming ability to hit an enemy character. Blue homing super fireworks will home in and deal significant damage to the closest enemy.

3.4 MINIGAMES

As the player progresses throughout the game they will encounter minigames, smaller games within the game focused on building the player's vocabulary. There are several types of minigames the player will encounter:

- NPC Dialogue Minigame: This minigame is started whenever the player talks with an NPC. This minigame brings up an NPC dialogue screen containing a "listen" button which will enunciate the NPC's message when pressed, a sentence area, and a multiple choice area. This minigame challenges the player to understand the meaning of the NPC's dialogue. NPC sentences are broken down into individual words. Each word is show by its hanzi, a pinyin button that pronounces the word when pressed, and a question mark button. By pressing the question mark button, the player will be given 4 multiple choice picture representations to choose from; one of these 4 pictures represent the meaning of the word in question. Selecting the correct picture will replace the question mark with the appropriate picture, as well as add the word to the player's Chinadex if it currently does not exist within it. If the player's Chinadex already contains a word used in the sentence, then the question mark will be replaced by the word's picture representation from the start of the minigame. This helps motivate the player to scan more objects within the game in order to collect their data. By using context clues and information about the level, the player can make a logical guess for the sentence's meaning, which can sometimes be a clue or instruction for the current level's objective. Implementing an NPC's dialogue as a simple minigame will give it a playful spirit, something suggested by Purushotma [13] for communication mechanisms. The introductory tutorial level uses simple phrases for NPCs such as "good morning" and "thank you", while successive levels increase in difficulty presenting the player with more complex sentence such as "I am not Chinese" and "Please follow me."

Figure 3.13: NPC Dialogue Minigame. By using context clues and information about their surroundings, the player can infer the meaning of the sentence to be "I am American."

- Matching minigame: This minigame makes the player match hanzi with its respective picture representation. Another variation of this game has the player match pinyin with picture representations.

- Replenish minigame: This minigame is used to replenish the player's arrows or fireworks. This minigame is similar to the matching game, but rewards the player with additional weaponry. This minigame is played by finding a replenish station, represented by a Chinese lantern. Different colored lanterns represent the specific reward the player will get by playing the minigame (e.g. arrows and fireworks).

Figure 3.14: Replenish Minigame. The player attempts to match picture representations on the left with Chinese characters on the right.

- Dates minigame: This minigame is first introduced in the 'Dates and Times' level. This game requires the player to examine a picture that symbolizes a specific calendar date, and fill in a list with specific characters to "write" the date. For example, the player may encounter a picture of a Christmas tree which symbolizes Christmas day, December 25th. The player would need to select the proper Chinese characters to write 十二月二十五日(December 25). This minigame builds off of the player's acquired knowledge of numbers.

3.5 3D ENVIRONMENT

Being a total immersion game, *Lost in the Middle Kingdom* required extensive use of artistic assets to teach the player and create the proper atmosphere. Types of assets include:

- 3D Models: These help create the various environments and levels within the game. This covers every in-game object the player sees, including weapons, terrain, buildings, trees, furniture, NPCS, etc.

- Model textures: Each 3D model contains at least one texture file. These textures give the model color.

- Terrain: This includes grass, flowers, trees, and terrain textures.

- Images: These are used for minigames, knowledge items, weapons, and menus. Each word used in the game requires an image for hanzi, pinyin, and picture representation. Knowledge items use images to display specific information to the player. Menus contain images for navigation buttons, inventory items, Chinadex entries, and backpack items.

- Music: Oriental background music is used to help create a Chinese atmosphere and make a cultural connection.

- Sound effects: Effects are used as auditory cues, word pronunciation, object, actions, and character actions. Positive and negative sound effects let the player know when they've answered a minigame question correctly or incorrectly.

3.6 – GAME ENGINE

Lost in the Middle Kingdom was built using the Unity game engine. The following attributes are important reasons for why we chose Unity:

- Provides a free version.

- Popular game engine used by developers both locally and internationally.

- Can easily port games to multiple platforms including PC, Mac, and Linux.

- Well-supported and contains several tutorials that illustrate basic game design concepts and strategies.

- Contains multiple tools and packages that assist developers in speeding up game development.

- Supports JavaScript and C#.

- Compatible with multiple 3D modeling software packages, image formats, and audio formats.

- User-friendly.

CHAPTER 4

STUDIES AND RESULTS

Lost in the Middle Kingdom was constantly playtested on a development level by its development team. This was done to remove bugs and improve game mechanics. To gauge how well it worked with players, playtesting outside of the development team was required.

4.1 STUDY 1 – GAMEPLAY EXPERIENCE

Our first study served to evaluate user experience with playing *Lost in the Middle Kingdom*. Participants in Study 1 were comprised of 12 college students taking an introductory Chinese language class at The University of South Carolina. Participants were given an internet link to download and install the latest version of the game to play wherever and whenever they like. Participants were asked to play the game for a maximum of 5 hours a week for three weeks, replaying previous levels after completing the game for repetition. They were also asked to record and email detailed information about bugs to the development team. After the 3 week testing period was over, participants took an anonymous online gameplay experience survey.

We used Likert scales with rankings of 1 (strongly disagree), 2 (disagree), 3 (neither agree nor disagree), 4 (agree), and 5 (strongly agree), to help us gauge player

experience. A copy of the survey can be found in Appendix A. Results from

Study 1 follow:

Table 4.1: Likert scale questions and scores from Study 1 where a score of 5 is desired.

Questions (a score of 5 is desired) N = 12	Mean Likert Score	Standard Deviation
The game was easy to control.	3.08	0.9
The game was interesting.	3.17	0.83
The game was intellectually challenging.	3.33	0.89
I enjoyed playing the game.	3.16	0.83
This game helped improve my Chinese vocabulary skills.	4.25	1.06
This game helped improve my Chinese grammar skills.	1.92	1.38
I liked the "total immersion" aspect of the game (no use of English, only Chinese).	4.00	0.74
I found playing this game more fun than traditional teaching methods (flash cards, dialogue drills, etc).	4.08	0.67
I would use this type of game regularly to aid myself in learning a new language.	3.42	0.8

Table 4.2: Likert scale questions and scores from Study 1 where a score of 1 is desired.

Questions (a score of 1 is desired) N = 12	Mean Likert Score	Standard Deviation
The game was stressful to play.	2.16	1.11
I found the game boring.	3.00	1.07
The game's interface was difficult to understand.	3.75	0.62
The learning material presented in the game was too hard.	1.67	0.65
I prefer normal teaching methods (flash cards, drills, etc.) over this type of video game.	2.08	0.9
This game would be better if English was used to explain gameplay, as well as the meaning of Chinese characters, pinyin, etc.	2.83	0.94

4.2 STUDY 2 – LANGUAGE LEARNING

Study 2 served as a way to measure how well our game teaches players basic
Chinese. Participants in Study 2 were comprised of 18 students with no prior knowledge
of the Chinese language. Before playing the game, participants took a short pretest
covering numbers, greetings, dates and time, and family. After taking the pretest,
participants were able to download and install the game. Players were asked to play each
of the game's levels 5 times each. After completing the levels, participants took a
posttest which was identical to the pretest. If a participant could not answer or make a
logical guess for a question, they were asked to leave it blank. This was done to reduce
false positives in test data. By having participants take the same test before and after
playing the game, we are able to measure any language gains due to the game. A copy of
the test can be found in Appendix B. Our test data follows:

Table 4.3: Pre and posttest data for Study 2.

Question Type	Pretest Mean % Correct	Posttest Mean % Correct	Gain
Part 1: Completing tables (hanzi to English)	8%	92%	+84
Part 1: Completing tables (hanzi to pinyin)	0%	34%	+34
Part 1: Completing tables (pinyin to English)	0%	84%	+84
Part 1: Completing tables (pinyin to hanzi)	0%	6%	+6
Part 2: Translating sentences (pinyin to English)	0%	39%	+39
Part 2: Translating sentences (hanzi to English)	0%	0%	0
Part 3: Translating dates (hanzi to English)	0%	82%	+82

Participants in Study 2 were also asked to take the same user experience survey from Study 1. Our Likert scale results follow:

Table 4.4: Likert scale questions and scores from Study 2 where a score of 5 is desired.

Questions (a score of 5 is desired) N = 18	Mean Likert Value	Standard Deviation
The game was easy to control.	3.08	1.78
The game was interesting.	3.17	1.11
The game was intellectually challenging.	3.78	1.06
I enjoyed playing the game.	3.61	0.85
This game helped improve my Chinese vocabulary skills.	4.33	0.91
This game helped improve my Chinese grammar skills.	1.56	0.90
I liked the "total immersion" aspect of the game (no use of English, only Chinese).	3.78	1.0
I found playing this game more fun than traditional teaching methods (flash cards, dialogue drills, etc).	4.00	1.28
I would use this type of game regularly to aid myself in learning a new language.	3.39	1.29

Table 4.5: Likert scale questions and scores from Study 2 where a score of 1 is desired.

Questions (a score of 1 is desired) N = 18	Mean Likert Value	Standard Deviation
The game was stressful to play.	1.72	0.67
I found the game boring.	3.17	1.1
The game's interface was difficult to understand.	3.72	0.96
The learning material presented in the game was too hard.	1.94	0.64
I prefer normal teaching methods (flash cards, drills, etc.) over this type of video game.	2.05	0.87
This game would be better if English was used to explain gameplay, as well as the meaning of Chinese characters, pinyin, etc.	3.39	1.2

4.3 SUMMARY

These two studies have provided valuable input about the current version of *Lost in the Middle Kingdom.* These studies have helped us understand which areas of the game work well as well ones that need redesign. Common suggestions and comments are listed below (excluding technical bugs):

- Certain levels felt too large. Players stated that the game contained many areas that felt empty and took too long to traverse. Players went on to suggest shrinking these areas or adding new architecture and/or objects to it.

- Most players had trouble finding the first unlockable gate which leads to the introductory tutorial level. Players suggested several methods that could help players understand the location of the first unlockable gate:

  o Instead of gaining the compass in the Tutorial level, players could acquire it after the first cutscene event occurs in the main temple of the overworld.

After leaving the temple and collecting the key, the compass would point to the first gate.

- o Create a large flag or marker near the first gate that the player will notice.

- Some aspects of the controls weren't easily understood. While most players found basic movement and camera rotation easy to understand, other mechanics such as pulling an object out of your backpack weren't. The tutorial level teaches this gameplay mechanic by requiring the player to place two books on two switches inside a room that contains only one book. Instead of scanning a book and pulling out multiple copies of it from their backpack, some players returned to a previous section of the level that contained a book, picked it up, and placed it on the switch. They then used the book inside the room to complete the second switch. The development team had hoped players would scan the single book in the room (which would add it to their Chinadex and backpack), use it to complete first switch, then use their backpack to pull out a new book and complete the second switch. Players also felt that toggling between walking and running should be controlled by the Left Shift key, not the X key.

- Discovering the weakpoint of level bosses was not easy. It took some players a while before figuring out how to inflict damage upon them.

Players also gave positive feedback, commenting on the strengths and potential of the game:

- In general, players felt like the game was a fantastic learning tool and unlike any educational game they've ever played. Most found playing *Lost in the Middle Kingdom* more fun than traditional learning methods.

- Most players said they would use this type of game regularly if they were trying to learn a new language.

- Players felt that the two levels focusing on numbers and dates/time worked really well. They felt confident in understanding the educational content presented in these levels. The various minigames used throughout these levels were also well-received.

- The immersive environment aspect of the game was enjoyed by most players. They liked the oriental music and being placed in a virtual representation of China. Some however did express a desire to see some parts of the tutorial level explained in English for ease of understanding. Some players found it difficult to learn new controls alongside new Chinese content.

Our pre and posttest data from Study 2 show very important results. Our study indicates that *Lost in the Middle Kingdom* works well for helping players translate hanzi to English as well as pinyin to English, with dramatic gains of +84 for both categories. However, players were incapable of translating a full Chinese sentence represented in hanzi into English. This is most likely due to the low amount of sentences in each level, decreasing the player's opportunity to hear these sentences in use. There was a

noticeable gain of +34 in the hanzi to pinyin translation category resulting in a posttest mean of 34. There was another noticeable gain of +39 in the pinyin to English category resulting in a posttest mean of 39. Implementing a new feature like speech recognition that asks the player to enunciate a word could potentially help improve these categories. The pinyin to hanzi category showed a gain of +6 and a posttest mean of 6. This low number is expected because the game does not teach the player how to write hanzi.

CHAPTER 5

CONCLUSIONS

Our two studies allowed us to evaluate both user experience and the effectiveness of our game. Even though the studies have concluded, the development process is not over. An educational game such as *Lost in the Middle Kingdom* requires regular feedback and redesign in order to improve its effectiveness.

5.1 SUMMARY

This thesis gives a detailed account of the conceptualization, design, and implementation of *Lost in the Middle Kingdom*, a serious game for language learning. The game's design is fundamentally sound and academically justified. From the start, the game has aimed to balance fun and intuitive gameplay with language learning in order to create an effective educational tool for all types of players. By using the Unity game engine, a functional beta version of *Lost in the Middle Kingdom* has been developed and tested. Feedback from players has been analyzed in order to improve the current version of *Lost in the Middle Kingdom*.

5.2 FUTURE WORK

Lost in the Middle Kingdom is not complete nor polished. Immediate future work includes completing the game's remaining levels which focus on shopping, hobbies,

school life, making appointments, visiting friends, weather, and transportation. These levels will require new language content meaning additional assets for each word's hanzi, pinyin, and pronunciation. Newer levels will require new spaces for the player to explore; this calls for additional 3D models, textures, and animations. Multiple areas of the game require redesign and implementation to improve usability as outlined in Section 4.3. As newer levels are completed, additional playtesting studies should be conducted in order to gauge user experience and how well these new levels teach their specific subject. Adding speech recognition into the game would help promote proper pronunciation and understanding of pinyin. If *Lost in the Middle Kingdom* is released to the public and considered a success, new video games teaching languages other than Chinese may arise. The design for *Lost in the Middle Kingdom* allows for easy translation to other languages. New Chinadex images and pronunciation recordings can be created to replace existing assets to conform to a different language. New 3D models will also need to be built to create a cultural connection.

Exploring new ways to educate individuals using interactive media is important. Video games engage and motivate learners. With further research and games like *Lost in the Middle Kingdom*, educational video game design will improve, helping to remove the negative views associated with these types of games.

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Appendix A

Video Game Experience Survey

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The game was easy to control.					
The game was stressful to play.					
The game was interesting.					
The game was intellectually challenging.					
I enjoyed playing the game.					
I found the game boring.					
The game's interface was difficult to understand.					
The learning material presented in the game was too hard.					

This game helped improve my Chinese vocabulary skills.					
This game helped improve my Chinese grammar skills.					
I liked the "total immersion" aspect of the game (no use of English, only Chinese).					
I found playing this game more fun than traditional teaching methods (flash cards, dialogue drills, etc).					
I would use this type of game regularly to aid myself in learning a new language.					
I prefer normal teaching methods (flash cards, drills, etc.) over this type of video game.					
This game would be better if English was used to explain gameplay, as well as the meaning of Chinese characters, pinyin, etc.					

General/Suggestions

How often do you play video games? _____

What is your age? _____

Is there something you think that can be added or detracted from the game to improve player experience?

_____

_____

_____

_____

Additional comments:

_____

_____

_____

_____

Are you a male or female?

- Male
- Female

What type of video games do you typically play?

- Action adventure
- Fighting
- Music and party
- Puzzle
- Racing
- Role playing
- Shooter
- Sports
- Strategy
- Simulation
- Educational

Lost in the Middle Kingdom Study Pre/Posttest

If you do not know the answer, simply type or write NA.

Part 1: Fill in the tables below.

Numbers

	Meaning	Pinyin
二		
十		
二十五		
六十四		
零		

Dates and Time

	Meaning	Pinyin
三月		
十月		
十二月		
年		
月		

Dates and Time

	Meaning	Pinyin
上午一点		
下午一点		
下午四点一刻		

下午六点半		
上午十一点三刻		

Dates and Time

	Meaning	Character(s)
xīngqīliù		
xīngqīyī		
xīngqīsān		
xīngqīwǔ		
xīngqī'èr		

Family

	Meaning	Character(s)
bába		
nǚ'ér		
gēge		
jiěmèi		
māma		

Miscellaneous Words

	Meaning	Pinyin
书		
人		
门		
房子		
苹果		

Part 2: Translate the following sentences:

1.) Wǒ shì Měiguórén.

Answer:

2.) Zhè shì wǒ de nǚ'ér

Answer:

3.) Wǒ Bù shì Yīngguórén.

Answer:

4.) 我是老师

Answer:

5.) 我是美国人

Answer:

Part 3: Identify the dates below:

1.) 十月三十一天

Answer:

2.) 十二月二十五天

Answer:

3.) 三月十五天

Answer:

4.) 七月二十四天

Answer:

5.) 一月十一天

Answer: