Foreign Language Learner Task-based Interaction in the Virtual World Minecraft

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Abstract (Japanese)

三次元仮想世界はこれまで、言語教育における潜在的な有用性を認識されながらも、使い勝手の問題や実行可能なタスクの制約から実際に教育現場で活用されることは稀であった。本論文では、この課題を解決するために行った３つの研究について報告する。

第１章と第２章ではまず言語教育における仮想世界の使用および適切なタスクの選択について先行研究を概観する。相互作用仮説をはじめとした、認知的・社会文化的要因に基づく仮想世界使用の根拠についても述べる。そして、ユーザビリティ（ユーザー自身が環境にどの程度手を加えられるか）の低さがタスクの複雑性を制限している現状を明らかにする。これに対して第３章ではユーザビリティの高い仮想世界として Minecraft を導入し、教育的文脈での使用に関する先行研究を概観する。

第４章では、１つ目の研究である小規模なパイロット研究について報告する。ここでは３組の大学生が Minecraft 上で３つのコミュニケーションタスクを行ったが、分析から参加者はタスクに成功し、有益な相互作用、特に意味交渉があったことが確認された。

第５章と６章では、２つ目の研究である本調査を報告する。15 人の参加者の５つのタスクにおけるやりとりの分析の結果、様々な流れの会話において高頻度な意味交渉が行われたことがわかった。各タスクの意味交渉頻度はタスクベースラーニング（TBLL）理論の予測と一致した。

第７章では日本の大学教員 42 名に対して行った意識調査について述べる。調査からはデジタルゲームや仮想世界の教育利用を制限するような課題への認識が明らかになるとともに、本調査で取り上げるユーザビリティの高いプラットフォームがこれらの多くの課題に対処できることが示唆された。

第８章では結論として、Minecraft が、複雑な言語タスクを可能とする優れた環境を学習者に提供することから、それが言語教育における三次元仮想世界使用の複数の課題に対処できることをまとめる。

Abstract (English)

Although three-dimensional virtual environments have been recognized for their potential usefulness in language education, they have rarely been used in actual educational settings due to usability issues and limitations on tasks that can be performed. This thesis reports on three mixed methods studies conducted to address this issue.

Chapters 1 and 2 first review previous research on the use of virtual worlds in language education and the selection of appropriate communication tasks. Rationales for the use of virtual worlds based on cognitive and sociocultural factors, including the interaction hypothesis, are also discussed. Then, the current situation, in which low usability (the degree to which users themselves can modify the environment) limits the complexity of tasks, is discussed in detail. In contrast to this, the following chapter (Chapter 3) introduces Minecraft as a highly usable virtual world and reviews previous research on its use in educational contexts.

Chapter 4 reports on the first study, a small-scale pilot study. Here, three sets of university students performed three communicative tasks in Minecraft, and discourse analysis confirms that participants were successful in the tasks and that the tasks elicited beneficial interactions in the target language, especially negotiation of meaning.

Chapters 5 and 6 report on the second study, the main study, in which discourse analysis revealed that the 15 participants' target language interactions during five tasks featured a high frequency of negotiation of meaning across various contexts. Further, the frequency of meaning negotiation in each task was consistent with the predictions of task-based learning (TBLL) theory.

The next chapter (Chapter 7) describes the third study, a survey conducted with 42 Japanese university faculty members on their attitudes regarding the use of

virtual worlds for language education. The survey reveals perceptions of issues that limit the educational use of digital games and virtual worlds, and suggests that the usability of the platform discussed in this study can address many of these issues.

The final chapter (Chapter 8) revisits the main findings that, taken as a whole, Minecraft provides learners with a robust environment that enables them to perform complex communicative tasks and which can address multiple challenges of implementing three-dimensional virtual worlds in language education.

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Biology to computer science to SLA. US to Canada to Japan. It's fair to say that I've taken a meandering path, but I'm thankful for all the places it has taken me to. *Thank you, mom. Thank you, dad. This would not have been possible without you.*

Next, I must thank Mark Peterson, my advisor at Kyoto University. Mark is extremely knowledgeable and helpful and has been a kind and patient friend over the years. The support and advice he provided for this research, and during my job search, were invaluable. This thesis would not have been possible without him.

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Glossary

BYOD	bring your own device
CALL	computer-assisted language learning
DGBL	digital game-based learning
L2	second language
MMORPG	massively multiplayer online role-playing game
SLA	second language acquisition
TBL	task-based learning
TBLL	task-based language learning
TBLT	task-based language teaching
TL	target language
VE	virtual environment
VW	virtual world
ZPD	zone of proximal development
3D	three-dimensional
3DVE	three-dimensional virtual environment

1 INTRODUCTION

In this thesis, I will present a mixed-methods analysis of sociolinguistic interaction in the target language (henceforth, TL) of university-level English language learners in a multi-user three-dimensional virtual world, drawing on an interactionist theoretical perspective, and placing particular emphasis on the design and implementation of communicative language learning tasks in these environments. In this introductory chapter, I will first briefly familiarize the reader with the use of computer software to assist in second language education, including the use of digital games and virtual worlds with three-dimensional environments. The role of communicative tasks in virtual worlds will then be introduced, noting that key aspects of such tasks are underexplored in the relevant academic literature. This gap in the literature will provide the key motivation for the current study. The chapter will conclude with a brief overview of the thesis and a description of each of the subsequent chapters.

1.1 CALL, DIGITAL GAMES, AND VIRTUAL WORLDS

In the field of second language education, one area of research that has received considerable attention in recent years, especially regarding new teaching methodology, is computer-assisted language learning (henceforth, CALL), due largely to the advances in digital technologies that have occurred over the past several decades (Butler-Pascoe, 2011; Peterson, 2013). Language educators were among the early adopters of computer technology in education, and their pioneering work has led to the development of CALL as a distinct field of research and practice (Peterson, 2013). This interest has continued to the present and the expansion in research has been noted in the literature (Chun, 2016). The field of CALL encompasses the study of a variety of different methods for using computer technology to enhance second and foreign language learning, and one of the most influential developments in contemporary CALL research concerns the use of multi-user three-dimensional (or

3D) virtual worlds and digital games (Hung et al., 2018; Lai et al., 2013; Peterson, 2013, 2016, 2017; Sykes et al., 2010). These interactive platforms are traditionally hosted on or accessed through standard internet-connected desktop or laptop computers and typically provide learners with the ability to operate a character (sometimes referred to as an "avatar") in a richly detailed and expansive three-dimensional virtual environment, or 3DVE. In these environments, learners typically have wide latitude to explore, observe, act, pursue goals, engage in creative expression, and collaborate and communicate with other participants. With these apparent affordances, it is easy to see why these platforms have attracted the interest of educators and researchers in second language acquisition (henceforth, SLA) as potential arenas for language learning.

The types of interactive 3DVE platforms that have received the most attention from SLA researchers fall into two broad categories, which will be referred to here has *virtual worlds* and *3D digital games*. Although both categories provide an interactive and multi-user 3D virtual environment, the term *game* will be reserved only for platforms that incorporate elements of *gamification*, such as the presence of explicit, built-in rules, objectives, and reward systems for measuring the progress of goal completion. Thus, 3D digital *games* provide users with both an interactive environment and a framework imposed by the game designers that directs what the users should do and how they should behave in the environment. One genre of these games that has attracted particular interest from SLA researchers is that of massively multiplayer online role-playing games—more commonly known as MMORPGs—in which thousands of players may simultaneously interact in a shared virtual environment as they complete game tasks known as "quests" for enjoyment and to advance the ranking of their characters. An example that has frequently been used in empirical research studies is *World of Warcraft* (https://worldofwarcraft.com) (Pardo

et al., 2004), an MMORPG that places users in a medieval high-fantasy world reminiscent of the works of J. R. R. Tolkien and the tabletop role-playing game *Dungeons and Dragons*. In contrast to games, *virtual worlds* will be defined here to provide an interactive environment without the explicit rules and goals that define gamified environments. Lacking this framework, virtual worlds are often designed as open environments to promote communication and social interaction among the users, making them seemingly ideal platforms for communicative approaches to language learning. A virtual world platform that has been the focus of a considerable amount of research in SLA is *Second Life* (https://secondlife.com) (Rosedale, 2003), which places users in a modern environment of buildings, city streets, dance clubs, parks, and other areas that somewhat resemble the real world.

Research on the use of games and virtual worlds in CALL has been elicited by the emergence of a substantial and growing body of work indicating that these environments provide access to conditions where language learning may occur (Peterson, 2008, 2017; Sadler, 2012; Schwienhorst, 2002), and many positive results and rationales have been described in the literature to support the use of these platforms for language learning. The most significant research in this area has been conducted in the form of empirical studies of learner interaction. Although in some cases researchers have examined the resultant sociolinguistic interaction of participants engaged with these platforms without providing specific tasks, in most studies researchers have chosen to examine the interaction of learners as they attempt to complete specific, researcher-specified communicative tasks. This is especially true with research on learner interaction in Second Life and other virtual worlds, since, again, these platforms lack the built-in objectives that define games. Such communicative tasks will be discussed in more detail in the following section.

1.2 COMMUNICATIVE TASKS IN VIRTUAL WORLDS

The use of communicative tasks in language teaching has received considerable focus in both classrooms and academic literature, and has, like CALL, developed into its own clearly defined subfield of SLA, called task-based language teaching, or TBLT (Nunan, 2004). Research in TBLT is principally concerned with understanding how communicative activities called "tasks" that feature practical, non-linguistic goals, can promote language learning by compelling learners to use and share their language skills to achieve meaningful and pragmatic goals. Compared to what may be possible in a traditional classroom filled with desks, chairs, pencils, and textbooks, it is not hard to conclude that three-dimensional virtual worlds potentially present new opportunities for task-based learner interaction. However, contrary to expectations, the development of tasks for language learner interaction in virtual worlds has so far remained underexplored in the research literature. The types of tasks that researchers have selected for previous studies do not always appear to take full advantage of either the possibilities afforded by the virtual environment or the principles of task design theory that have been richly developed by TBLT researchers. Although a range of tasks have been used in empirical studies of learner interaction in virtual worlds, most researchers have tended to select relatively simple tasks involving open-ended communication about particular topics. While such tasks have been shown to be sufficient for some virtual world investigations, the possibilities for more complex tasks remain in need of further exploration.

Perhaps one reason that has guided researchers towards the selection of—for lack of a better term—simple communication tasks, is that the field of virtual world studies, like the field of CALL itself, is still at an early stage of development. Many studies are exploratory or preliminary in nature, and researchers have often decided to focus on other aspects of virtual worlds rather than the development of

communicative tasks. However, another possibility is that the virtual worlds themselves have presented challenges to the implementation of more fully developed tasks. Second Life, the most used virtual world in research studies to date, is restricted by its developer to be accessible only on its own commercial servers. To prevent abuse and vandalism in these virtual environments, constraints are often imposed by administrators that limit what actions users can take, such as removing the ability to make any significant modifications to the environment. Further, even if such modifications were allowed—even in a limited way—the expertise required to implement them may be beyond the available skills of students, teachers, and even some researchers. Any significant modification of the environment in Second Life, for example, requires the use of complex geometric design tools and writing instruction scripts in a custom computer programming language (Linden, 2018)—skills that are undoubtedly beyond the scope of typical language learning programs. Given these apparent challenges, the next section will briefly introduce Minecraft as a potential alternative arena for communicative tasks.

1.3 MINECRAFT

Although Second Life is by far the most used three-dimensional virtual world in the relevant research literature, it may not be the only possible choice. The 3D multi-user environment *Minecraft* (www.minecraft.net) (Persson & Bergensten, 2009) is a far more easily modifiable platform that has been seemingly underexplored as an arena for language learning tasks. Minecraft lies somewhere on the spectrum between games and virtual worlds. The platform, which is described in more detail in Chapter 3, provides a whimsical 3D environment in which almost all material appears as large blocks that players are typically allowed to interact with by collecting, moving, and destroying. In its standard variation, Minecraft does provide features enabling the platform to be construed as a game, with the primary objective of surviving in a hostile

environment and eventually killing a dragon. However, because Minecraft does not provide any type of system to explicitly direct users toward these goals—such as awarding points, ranking the users, or stating objectives—the users of Minecraft are thus free to set their own goals. In practical terms, and particularly in educational contexts, Minecraft is far more commonly used as a virtual world with no gamification at all provided by the platform itself (Petrov, 2014).

When used as a virtual world, Minecraft offers a range of features that make it appear to be an especially accommodating platform for task-based language learner interaction. Unlike Second Life, users are allowed to host their own private Minecraft servers over which they can assert full administrative control. And perhaps more importantly, Minecraft's blocks-world style design allows for far simpler mechanics for users to create or destroy structures and make other meaningful changes to the environment which could potentially serve as the basis for communicative language learning tasks.

1.4 Theoretical Framework

Thus far, I have made three key assertions: that Second Life is the dominant platform for previous studies of language learner interaction in virtual worlds; that communicative tasks in these studies have tended to underexplore the use of TBLT task design theory; and that Minecraft may offer usability features that make it more suitable than Second Life for the implementation of communicative tasks. Each of these assertions will, of course, be thoroughly defended in subsequent chapters. For now, they serve to identify a gap in relevant research literature that this thesis will seek to address. Through a mixed-methods empirical analysis of learner interaction, this thesis will explore the use of task-based learning in virtual worlds using Minecraft, with the goal of contributing evidence that task-based communicative

activities can function well in virtual worlds and that Minecraft is a suitable arena for such tasks.

As with nearly all related work in SLA, the overall evaluative framework here will be firmly interactionist in nature, rooted in the Interaction Hypothesis (Long, 1981). The central premise of this is that meaningful and comprehensible interaction in a target language by a language learner with another interlocutor plays an indispensable role in the process of language learning. This theoretical approach will allow for a flexible analysis of any observable sociolinguistic interaction that may occur during the data collection phase of the following research, and since related research on TBLT and virtual worlds also generally adopts an interactionist framework, adopting a similar approach here will allow for more meaningful comparisons to previous results.

This broad theoretical framework necessitates the adoption of a similarly flexible methodological approach, and so the research presented here will use mixed methods. Mixed methods research allows for the collection and analysis of both quantitative and qualitative data, and has frequently been used in research in CALL and other subfields of SLA as it allows for taking a broad perspective on any gathered data and may help to facilitate the identification of new phenomena that might not be identified by more narrowly defined methodologies (Abbuhl & Mackey, 2017; Hashemi & Babaii, 2013).

1.5 Thesis Outline

The remaining chapters will proceed as follows: Chapter 2 contains a comprehensive literature review and describes the theoretical justifications noted in the literature for the use of digital games and virtual worlds in language education. By way of this, the chapter also provides some background on the two main theoretical

perspectives of second language learning: the cognitive perspective, and the sociocultural perspective. Chapter 2 also provides theoretical background on TBLT and the use of communicative tasks in language learning as well as a detailed overview of tasks in previous studies of virtual worlds. This background will demonstrate a need for researchers to consider alternatives to the virtual worlds that have dominated previous work in the field (in particular, Second Life). Chapter 3 provides a detailed introduction to the virtual world Minecraft as a possible alternative, suggesting that Minecraft offers a promising platform for the implementation of complex communicative language learning tasks, thus providing the primary motivation for the research described here. Chapter 4 presents a previously published small-scale pilot study (Swier, 2014), in which six undergraduate university students worked in pairs to complete three communicative tasks during single sessions. Using a mixed methods approach including discourse analysis, researcher observation, pre- and post-study questionnaires, and post-study interviews, the study provides evidence of Minecraft's suitability as a platform for complex communicative tasks and serves as the basis for a larger study described in the following chapters.

Chapters 5 and 6 describe the main (larger) study in this research, which more directly explores Minecraft's potential as a component of university-level language courses and expands on the pilot study in that the participants shared not only the virtual space within Minecraft but were also able to interact using real (non-virtual) space that they shared with their communicative partners. As the chapters will show, the study participants were able to take advantage of these dual shared spaces to engage in rich and effective multi-modal interaction in the target language in order to successfully accomplish the goals of their communicative tasks. This study also employed mixed methods involving qualitative and quantitative discourse

analysis (discussed in Chapter 5) and researcher observation, questionnaires, and post-study interviews (discussed in Chapter 6). The principal conclusions are that the design features of Minecraft give the platform a great potential for supporting goal-orientated communicative tasks and may support successful integration into university-level language classes.

Chapter 7 presents previously published work (Swier & Peterson, 2018) that attempts to place the positive results of Chapters 5 and 6 into greater context. In the large and growing body of CALL literature on digital games and virtual worlds, positive results are frequently reported. And yet, the adoption of these techniques in regular university-level language classes remains extremely low. The chapter revisits the work of Bachnik (2003) on documenting the challenges to adopting technology in higher education in Japan, and reports on a survey of university English instructors in Japan regarding their attitudes towards CALL and the use of digital games and virtual worlds. The results show that the cultural and institutional challenges Bachnik described in 2003 remain largely in place at present, despite considerable advances in information technology and an overall positive view among educators regarding the potential benefits of these technologies for language learning. Results suggest that user-friendly platforms such as Minecraft may address some of these challenges and point to areas of future research that may be needed before such technologies see wider adoption in higher education.

Finally, Chapter 8 summaries the main conclusions from the thesis on seeking to understand and address challenges that have faced the use of virtual worlds in second language education and closes with thoughts on promising future directions.

2 LITERATURE REVIEW

This chapter will present background information and a review of relevant academic literature that will serve to contextualize this thesis research within SLA and the field of CALL, and which will serve to highlight a gap in the literature which this work will address. The chapter will begin with an examination in Section 2.1 of the theoretical rationales presented in the literature that support the use of 3DVE platforms in SLA contexts. Further background will be provided in Section 2.2 with a brief introduction to the field of task-based language learning and the role that communicative tasks have played in SLA. Section 2.3 will discuss part of the intersection of these two areas of interest and present a literature survey on the types of communicative tasks that have appeared in empirical studies of virtual worlds in SLA. This review will reveal striking limitations in the types of tasks that have appeared in previous studies. Reasons for these limitations will be discussed in Section 2.4. Finally, the literature review will be summarized in Section 2.5, and the necessity for further research will be noted.

2.1 RATIONALES FOR THE USE OF 3D ENVIRONMENTS IN SLA

There are many ways to learn a language, including many ways that do not require computer hardware. So why use 3D virtual environments in language learning? Formal language education programs predate the existence of computers and have not traditionally had a close association with computers or games of any sort. The cost of procurement and maintenance of computer systems alone presents one obvious barrier to the wide adoption in language programs. The task of shifting to games and game-like systems and away from entrenched, traditional methodologies presents another. It is important, therefore, that any suggestions for the use of computer games and virtual worlds in language education begin with a sound theoretical justification.

Table 1: Rationales for the use of 3D digital games and virtual worlds in CALL

Cognitive rationale	• Opportunities to engage in purposeful target language interaction facilitate negotiation of meaning and individualized learning • Anonymity reduces barriers to learning and fosters participation, motivation, and risk-taking
Social rationale	• Fosters social interaction in the target language • Facilitates membership in online communities supporting collaboration, teamwork, and language socialization • Low-risk environments offer opportunities to engage in peer-based dialog providing exposure to zones of proximal development

From Swier and Peterson (2018)

The background presented in this chapter is adapted and expanded from Swier & Peterson (2018).

2.1.1 TWO PERSPECTIVES

The promise of 3D digital games and virtual worlds lies primarily in their potential for inspiring learner motivation and willingness to communicate while also providing an effective and efficient environment for engaging in that communication (Peterson, 2011; Sadler & Dooly, 2013). 3D virtual environments are believed by many researchers to provide opportunities to take actions and engage in communicative activities that would otherwise be difficult or impossible to accomplish while seated in a standard university classroom. In particular, researchers have drawn on developments in contemporary SLA theory to assert that features of these environments are highly likely to support language learning (Thorne et al., 2009). The most influential theoretical rationales proposed to justify the use of these environments draw on accounts of SLA that center upon the role of interaction in second language learning (Peterson, 2011; Reinhardt & Sykes, 2012). As summarized in Table 1, these accounts can be broadly classified into two categories: those that draw primarily on cognitive factors related to language acquisition, and those that

draw more directly on the sociocultural factors that impact language use. Although clear differences exist, it is important to note that these rationales are indeed complementary and may be thought of as different perspectives on the same complex phenomenon. Researchers who focus on cognitive factors certainly do not deny the sociocultural functions of language use, and those who focus on sociocultural factors do not deny that cognition plays an essential role in language processing. Secondly, both rationales are situated squarely within the interactionist framework that is the foundation of much work in modern SLA, and which will be described in the following section.

2.1.2 THE INTERACTION HYPOTHESIS

As mentioned in the previous chapter, the interaction hypothesis holds that comprehensible interaction in a target language is an essential part of the second language learning process. Comprehensible interaction here refers to any linguistic input from a conversation partner that is understandable to the learner. Additionally, the hypothesis holds that this linguistic interaction must be subject to a process of negotiation, where utterances for which the meaning is initially unclear are made to be mutually comprehensible through a collaborative effort of clarification and modification by the conversation partners to reach a shared understanding (Long, 1981).

The earliest descriptions of the interaction hypothesis come from Long (1981), and the idea is closely related to Krashen's (1977, 1985) input hypothesis, which holds that language acquisition occurs when learners receive and understand linguistic input that contains previously unlearned features. Both ideas incorporate the notion that language learning is likely to occur when a learner is interacting with an interlocutor who is more competent in the language or who at least has learned some linguistic features that have not yet been acquired by the other learner. These

concepts are related to much earlier work by the Russian psychologist Lev Vygotsky in the early 1930s, who developed the concept of a "zone of proximal development" or ZPD (Vygotsky, 1978). The ZPD is described as a range of task difficulty within which learners are able to complete tasks with assistance, or "scaffolding," from more competent partners. The ZPD is conceptually situated between easier tasks in the target language that the learner has already mastered enough to complete without assistance and those harder tasks that are so far beyond the learner's competence level that they cannot be completed even with assistance.

Reasons that the meaning of an utterance might be initially unclear to a listener can of course include a lack of linguistic competence on the part of one or both interlocuters. For instance, the utterance could contain vocabulary unknown to the listener, or could contain lexical or grammatical errors made by the speaker. However, it is also possible that the utterance was ambiguous in its meaning (thus making the speaker's intent impossible to determine) or was simply misheard or misspoken. Interlocuters can then use a variety of strategies to negotiate a shared understanding of the utterance's meaning. Pica (1994) and Long (1996), for example, identify five such strategies: the listener may request clarification from the speaker, the speaker may request confirmation that the listener understood, the speaker may simply repeat the utterance, the speaker may explain the meaning by elaborating, and the speaker may rephrase the utterance in a simpler way.

In additional to resolving the meaning of unclear utterances, strategies for negotiation of meaning are also used to establish and actively maintain states of intersubjectivity (Antón & Dicamilla, 1999), or a shared understanding between interlocuters of the meanings of words and concepts under discussion and the relevant context of the current discussion. For example, even in cases where listeners likely understood a speaker's initial utterance, communication strategies such as repetition,

clarification, and confirmation, may be used throughout the course of linguistic interaction to signal attention, understanding, and encourage further interaction with a communication partner (Peterson, 2012b). These skills have been seen in the literature as playing an important role in the development of sociocultural competence that may contribute to successful language learning (Lafford, 2007).

Although it might be assumed from the above description that this type of linguistic interaction is most beneficial for language learners when paired with a teacher or native speaker, work on the interaction hypothesis by Pica (1987) found that negotiation of meaning occurred more frequently in student-to-student interaction during collaborative tasks than with interaction between students and teachers. Pica influentially concluded that social equality between the interlocutors encouraged the use of clarification and checks for comprehension in collaborative communication task scenarios.

Thus, the assertions of the interactionist framework may be summarized as follows: that meaningful interaction in the target language is essential for language acquisition, that interaction must include initially incomprehensible input that is made understandable through a process of negotiation and/or scaffolding, and that this negotiation for meaning is most likely to occur between interlocutors with shared goals and equal social status.

As mentioned, both cognitive and sociocultural competence are factors in the language acquisition process, and both can be developed through meaningful interaction in the target language. The remainder of Section 2.1 discusses rationales for the use of games and virtual worlds based on each of these factors.

2.1.3 Rationales Based on Cognitive Factors

It is claimed from the perspective of cognitive accounts of SLA that these environments provide exposure to the target language in a context conducive to learning (Zhao & Lai, 2009). Researchers emphasize the importance of findings reported in learner-based research, suggesting that because many virtual worlds and digital games are designed to compel learners to undertake purposeful, real-time interaction in the target language, they provide opportunities to encounter communication issues relating to meaning (Y.-J. Lan et al., 2016; Milton et al., 2012; Wigham & Chanier, 2013). This aspect is perceived as supporting vocabulary acquisition (Rankin & Shute, 2010) as it enables individual learners to engage in the types of linguistic interaction involving feedback and the production of modified target language output that are identified in cognitive accounts of SLA as playing a central role in language learning (Long, 1996). Proponents of the cognitive rational also draw attention to research involving use of digital games that has produced findings indicating that vocabulary learning may be enhanced when digital games and virtual worlds are integrated into regular classroom activities (Hitosugi et al., 2014; Liou, 2012) or are used in combination with supplementary materials (Miller & Hegelheimer, 2006; Ranalli, 2008)

Another major element of the cognitive rationale focuses on affective factors. Researchers who advocate the use of these environments based on the cognitive rationale assert that the presence of individual avatars and persistent virtual worlds featuring high quality graphics serve to promote engagement, emotional investment, and immersion (Cooke-Plagwitz, 2013; Liou, 2012). Researchers also claim that the anonymity provided by the use of pseudonyms supports the risk-taking that plays an important role in language acquisition (Bytheway, 2019; Jauregi et al., 2011). It is further noted that this feature may act to reduce barriers to learning, such as anxiety

(Melchor-Couto, 2017; A. Wang et al., 2013). Moreover, supporters of this rationale draw attention to research indicating that the learner-centered nature of these environments facilitates the development of autonomy (Collentine, 2011; Suh et al., 2010). Findings reported in the literature suggest that the above aspects of these environments combine to facilitate participation (Deutschmann et al., 2009), willingness to communicate (Reinders & Wattana, 2011, 2014, 2015), and motivation (Y.-J. Lan et al., 2016; Wehner et al., 2011).

2.1.4 Justifications Based on Sociocultural Factors

Accounts of SLA that emphasize the social nature of language learning represent an alternate source of theoretical justification for the use of these environments in CALL. Researchers assert that from this perspective, many virtual worlds and digital games are particularly promising venues for CALL as they are frequently designed to elicit social interaction, providing access to contexts where language learning may occur (Peterson, 2016; Sykes et al., 2008). Proponents of this view draw attention to research indicating that digital games and virtual worlds that are designed to facilitate teamwork and other forms of collaboration can offer learners opportunities to engage in authentic and potentially valuable forms of target language discourse (Liang, 2012; Peterson, 2012a; Zheng et al., 2009, 2015). In this context, studies suggest that the online communities associated with many digital games and virtual worlds provide low-risk venues where learners can experience language socialization and participate in authentic peer-based collaboration in the target language (Lee & Gerber, 2013; Peterson, 2010, 2012a; Rama et al., 2012). Researchers claim that these environments provide language learners with opportunities to access zones of proximal development where language skills may be developed through target language interaction involving assistance from more capable peers (Sykes et al., 2010; Thorne, 2008).

2.1.5 Summary of Rationales and Challenges to Adoption

The rationales and positive findings discussed here suggest that digital games and virtual worlds may provide advantages over conventional forms of learning by providing opportunities to engage in interaction that is viewed as beneficial from both the cognitive and sociocultural perspectives on language learning. A substantial and growing number of experimental studies have been conducted to date, and positive results have been widely reported. However, much less research has been conducted on the use of these environments in formal institutional settings (Blasing, 2010; Collentine, 2011; Deutschmann et al., 2009; Hitosugi et al., 2014; Liou, 2012; Reinders & Wattana, 2014, 2015; Suh et al., 2010; A. Wang et al., 2013; Wigham & Chanier, 2013), and it must be noted that outside of military and corporate training programs, implementation in formal educational contexts remains extremely limited (Chik, 2012).

The low rate of adoption of digital games and virtual worlds in formal education may be surprising given the sound theoretical justifications, successful experimental results, and ubiquity of powerful computing devices in modern society. However, researchers have noted that attitudes of educators and learners towards the use of games (especially digital games) and virtual worlds in formal education often present challenges to the adoption of these techniques, and that institutional support for incorporating games and virtual worlds into learning curriculums is often limited (Lee & Gerber, 2013; Wiggins, 2016). Further, work by Bachnik (2003) on the adoption of information technology at Japanese universities found that there are deeply entrenched obstacles to the use of technology in the classroom, sometimes even despite the availability of the technology itself and widely held beliefs that technology use may be beneficial. Thus, despite the clearly articulated rationales discussed in this section, implementation of these methodologies outside of research contexts

remains an issue. In the next section, I will continue the background explanation with a discussion of communicative tasks and the field of TBLT.

2.2 Communicative Tasks and Task-based Language Teaching

A principal component of this research involves the implementation of communicative tasks in a virtual world. In the following discussion, I will review the relevant research on communicative tasks and their role in the field of task-based language teaching, one of the leading approaches to SLA in recent years.

The early roots of TBLT lie in changing attitudes towards second language instruction that began to emerge in the 1970s, due in large part to the work of Hymes (1971) and Halliday (1973). This pioneering work helped lead to the development of a theory of communicative competence and helped to popularize the idea that, in the context of SLA research, it is often helpful to view language in terms of its practical communicative functionality rather than in terms of abstract syntactic structures. That is, instead of conceiving of language acquisition as a process of memorizing discrete units of lexical and grammatical knowledge, as traditional methods had largely done (and continue to do), language teaching approaches that began to focus on the development of communicative competence placed far greater emphasis on developing the skills and social knowledge necessary to engage in meaningful and successful communication in the target language. As this functional view of language started to become more influential, Krashen and others began to formulate a view of learning that centered around incidental acquisition through participation in communicative activities, or *tasks*, with other learners or more competent speakers (Krashen & Terrell, 1983). As interest in communicative tasks grew, it became increasingly necessary for researchers and educators to develop theories about the types of tasks that best promoted language acquisition and to develop curricula that

incorporated such tasks successfully (see overviews by Bygate et al., (2001) and Ellis (2003)).

In the earliest work on TBLT, researchers tended to focus on tasks related to real-world goals and activities. The widely cited description from Long (1985) of 'tasks' as being the "hundred and one things people do in everyday life, at work, at play, and in between" (p. 89) makes this point clearly, including examples such as dressing a child and buying a pair of shoes. The key observation is that language use in the real world is usually as a means of communicating ideas or information in service of a practical goal which very often is not related to language at all, and that these communicative acts will be judged as successful if the goal is achieved. As Nunan (2004) noted, researchers eventually began to focus on more explicitly pedagogical communicative tasks as these methods were brought into the classroom and came to be more deliberately incorporated into programs of study. However, throughout this shift in focus, the practical goal-orientated elements of real-world tasks were maintained.

2.2.1 TASK TYPES

Prabhu (1987) is widely regarded as the first to fully describe a language course centered around communicative tasks. Prabhu's framework also included an early and highly influential description of several types of tasks that he had found successful with his own students. Each of Prabhu's task types centered around a *gap* of some type between the learners. Typically working in pairs or in a small group, the goal of each task requires that the learners bridge the gap between them by communicating effectively in the target language. Moreover, the type of task in Prabhu's framework is defined by the type of gap. As shown in Table 2, the three types of tasks that Prabhu defined were *information gap*, *reasoning gap*, and *opinion gap*.

Table 2: Main task types in the framework of Prabhu (1987)

Task type	**Description**	**Example**
Information Gap	Partners begin task with differing information; must successfully communicate information to complete the task. Generally involves a single solution.	Provide similar but non-identical images to each partner; partners must verbally describe the images to identify differences
Reasoning Gap	Partners begin task with shared information; must use discussion and reasoning to derive target information. Involves a single solution or tightly constrained set of solutions.	Partners must decide on a plan for a vacation or other event with a limited budget and other constraints
Opinion Gap	Partners face questions or scenarios involving value judgements or other expressions of personal opinion. Opinions should be explained and justified. No fixed solution.	Deciding on the best way to complete a story; Choosing the most appropriate gifts for different scenarios; Discussing a social issue

Tasks with gaps in information involve creating an arrangement where one participant is in possession of information that is necessary for a partner to complete a task. Successful completion of the task thus depends on successfully communicating the necessary information from one partner to the other. In two-way information gap tasks, each partner begins the task in possession of information that the other needs, thus necessitating a successful two-way transfer of information. Additionally, information gap tasks are often designed so that information needs to be converted to a linguistic form from a graphical or other non-linguistic form. For instance, the necessary information for completing the task could be provided visually to one partner—in the form of a map, picture, or other graphical representation—but the task could require that information to be communicated verbally to the other partner. A common example of information gap tasks involves providing similar but slightly

different pictures to each partner and asking them to identify the differences by sharing information about the images verbally.

Reasoning gap tasks require the participants make decisions and/or derive new information from a provided set of initial conditions and constraints for a task, often in the form of collaboration on the creation of a plan. Such plans could include taking a trip, buying gifts, or planning an event. Unlike information gap tasks, with reasoning gap tasks each participant has access to all the necessary information to complete the task. However, as the tasks are framed as collaborative exercises, participants still experience some compulsion to engage in communication in order to come to an agreement on the plan or other result of the reasoning process. Similarly, in opinion gap tasks, the participants also each begin the task with all necessary information and must simply respond to questions or scenarios for which they are asked to express their personal opinions or preferences.

One of the key features of Prabhu's framework is that, regardless of the type of task, the goal is never itself a linguistic goal, such as a fill-in-the-blank vocabulary exercise or answering reading comprehension questions. The goal is always defined by something other than a target linguistic output, and—were language learning not an issue—could be accomplished in the participants' native languages as well. Second language use during the task is thus open to a process of meaning negotiation between the participants. The participants are free to focus on meaning, and the use of language functions as a practical tool for communicating ideas and information, rather than as its own end without any communicative intent on the part of the learners. Importantly, the information exchanged during these tasks does not need to be limited to the logical structure of the task itself, and may serve a wide range of linguistic functions, including the establishment and maintenance of intersubjectivity,

or the rapport and sense of mutual understanding that is thought to play a key role in social interaction (Antón & Dicamilla, 1999).

Over time, other frameworks for tasks have emerged in the research literature, including that of Pattinson (1987), which defined seven types of tasks, and work by Pica, et al. (1993) and later Richards (2001), describing five types: *jigsaw* (participants analyze and piece together information), *information gap*, *problem solving*, *decision making*, and *opinion exchange*. This latter framework is summarized in Table 3. Although the various task frameworks do include some differences, there has been widespread agreement among researchers in TLBT on the essential functions of a communicative task, which was summarized thus by Ellis and Shintani (2014): the linguistic focus should be on meaning rather than form; there should be some kind of gap to create a need to communicate; learners should rely mainly on their own linguistic skills and knowledge; and there should be a clearly defined communicative outcome or goal by which success of the task can be evaluated. At the same time, there has also been widespread agreement that not all types of tasks are equal in the degree to which they promote negotiation of meaning, with more open-ended tasks such as decision-making and opinion exchanges expected to promote negotiation of meaning to a comparatively lesser degree than those involving problem-solving or bridging gaps in information (Pica et al., 1993).

Finally, it should be noted that although work in task-based language teaching focuses developing skills in the practical, communicative functions of language, the research in this area is agnostic regarding the precise nature of the language acquisition process. That is, researchers who focus on cognitive accounts of acquisition, as well as those who focus on the sociocultural aspects of acquisition, have both found value in the use of task-driven communicative interaction. This may be one reason the technique has found such wide adoption in the field of second language

Table 3: Main task types in the framework of Pica et al. (1993) and Richards (2001)

Task type	**Description**	**Example**
Jigsaw	A type of information gap task where two or more partners are provided with different information which must be combined in order to complete the task; Generally involves a single solution	Picture ordering task in which each partner receives a picture representing a different event; group must decide on the most probable chronological sequence for the images
Information Gap	Partners have differing and complementary information which must be successfully communicated to complete the task	Find a specific location on a map using directions provided to the other partner
Problem Solving	A type of reasoning gap where partners begin with shared information which must be discussed and logically analyzed to solve a problem; Generally involves a single solution	Derive the teaching schedule of a particular teacher given the class schedules their students
Decision Making	A type of opinion gap where partners begin with shared information which must be discussed and evaluated (possibly with a value judgement) in order to make a decision; No fixed solution	Select a limited number of items from a list to have available when stranded on a deserted island
Opinion Exchange	Partners discuss and provide reasons for their own opinions about an issue. No need to come to agreement	Discussion of a relevant social issue (e.g., *Should tobacco use be banned in public places?)*

teaching. But as will be discussed in the next section, these types of communicative tasks have been underexplored in empirical studies of learner interaction in virtual environments, due to software design limitations and the potentially limited expertise of the study participants.

2.3 COMMUNICATIVE TASKS IN VIRTUAL WORLDS

As mentioned, the most significant studies involving 3D virtual environments in language education have taken the form of empirical studies of learner interaction. As research in this area of CALL is still at a relatively early stage, the principle goal for many empirical studies has thus far been the necessary task of identifying and verifying such affordances for language acquisition across the range of available 3D platforms, including commercial MMORPGs, games designed specifically for educational purposes, and virtual worlds (see Peterson (2013) for a summary). Typically, these studies assign a large part of their focus to providing an analysis of the linguistic and social interactions of language learners as they engage tasks set in the 3D environment by game designers or by the researchers or educators themselves. The use of researcher-specified tasks is particularly common for the subset of this research involving virtual worlds, as these open environments lack explicit goals by design. Table 4 summarizes the chosen virtual world and communicative tasks of 34 recent and significant studies that have appeared in major CALL journals. As can be seen from the table (shown over several pages because of its large size) most studies have chosen to explore several different researcher-designated tasks. The following sections will first summarize the types of tasks that have been used in these previous studies and will conclude that learner tasks that have appeared in the literature to date have been limited in both the level of engagement they foster between the learner

Table 4: Summary of tasks in previous studies of virtual worlds

Study	Virtual World	Description of Tasks
Toyoda & Harrison (2002)	Active Words 3D	Engage in free discourse with a native partner
Peterson (2005)	Active Worlds 3D	Opinion exchange: "What are the best ways to master English?"

Study	Virtual World	Description of Tasks
Peterson (2006)	Active Worlds 3D	Jigsaw picture arrangement; discuss options in selecting a gift; exchange opinions about ideal marriage partners
Deutschmann, et al. (2009)	Second Life	Self-introduction role play; give short presentation
Deutschmann & Panichi (2009)	Second Life	Engage in discourse about personal topics; give short presentation
Peterson (2010)	Second Life	Explain virtual world features to peer; opinion exchange about flu outbreak; give short presentation
DuQuette & Hann (2010)	Second Life	Provide directions to a specific location; arrange furniture in a room
Wehner, et al. (2011)	Second Life	Interact with other users and submit chat transcripts to instructor
DuQuette (2011a)	Second Life	Discuss stories read outside of the virtual world
Jauregi, et al. (2011)	Second Life	Complete questionnaire and discuss cultural differences and similarities; explore and discuss a location in the virtual world; discuss areas explored in virtual world with native partner; discuss overall experience in virtual world
Cornillie, et al. (2012)	Custom platform	Complete interactive automated dialogs with corrective feedback, related to introducing people and business networking.
Peterson (2012)	Second Life	Treasure hunt; opinion exchange about improving language education in Japan; opinion exchange about a flu outbreak; short presentation
Milton, et al. (2012)	Second Life	Situational role-play activities (bank, travel agency, museum, supermarket, etc.)
Liou (2012)	Second Life	Orientation to virtual world and free discourse; peer-review editing; tour of virtual world
Liang (2012)	Second Life	Role-playing, including visual puzzle solving, verbal duels, reading poems, treasure hunt.
Henderson et al. (2012)	Second Life	Ordering food in a restaurant; giving directions; buying grocery items
Wang et al (2012)	Second Life	Virtual tours; virtual lectures; group discussions; interviews
Kruk (2013)	Yoowalk	Non-communicative… limited to repetition and practice of specific grammar point (English second conditional)
Wang et al. (2013)	Second Life	Discuss cultural differences related to language and gender; Explore beliefs related to language and gender; Debriefing

Study	Virtual World	Description of Tasks
Wigham & Chanier (2013)	Second Life	Information gap building activity. One participant has information on target form for a building, other participant must build it
Jee (2014)	Second Life	Picture ordering jigsaw task (printed handouts); discuss appropriate gifts for host family; "What is the best holiday in your country?"; "Talk about the gift-giving custom in your country."
Lan (2014)	Second Life	Simply duplicated normal classroom instruction and methods and conducted them in VW
Kruk (2015)	Active Words 3D	Grammar point practice (English present simple tense).
Lan (2015)	Second Life	Playing a ring toss game and practicing ordering at a restaurant. Used as classroom activities but duplicated in SL
Wigham & Chanier (2015)	Second Life	Same building task as above study; reflection and discussion
Chen (2016a) (crossroads)	Second Life	Visit museum; order at a restaurant; show-and-tell about "national costume"; Act as tour guide;
Chen (2016b) (strategy use)	Second Life	Exchange opinions on which English skill are difficult to learn; Exchange opinions on real world vs. virtual world learning; Giving map directions (information gap); Build an object in SL; Spot differences in pictures; Choose a restaurant; Choose a birthday gift for a classmate
Lan et al. (2016)	Second Life	Implementation of tasks in SL seems to have mostly involved chatting and observation.
Levak & Son (2016)	Second Life	Greetings and introductions; following directions; scavenger hunt; describing objects; shopping; ordering at a café; weather and news reports; describing an event
Melchor-Couto (2017)	Second Life	Discuss national stereotypes; Watch videos and talk about them; Talk about dangers of social networks; Travel to a place in SL
Canto & Jauregi (2017)	Second Life	Visit a virtual apartment; Self-introductions; Decide on a place to visit in the VW; Talk about vacations; Various role-plays
Yamazaki (2018)	Meet Me	Daily life tasks (using public transportation, shopping, driving, socializing, fishing)
Chen & Kent (2020)	Second Life	Restaurant role-play, 3D object building, maze completion, interviews, show-and-tell presentations
Yang et al. (2022)	Second Life	Ordering at a restaurant in a virtual Chinatown

and the virtual world and in the degree to which the principles of task-based learning have been applied. The discussion will conclude with an examination of factors that may have influenced and limited the scope of learner tasks for virtual worlds that have appeared thus far in the literature.

2.3.1 Tasks Involving Free, Open-ended Dialog

As shown in Table 4, fully half of the studies identified for review include tasks that involve open-ended dialog, conducted either through text chat or voice communication, in which learners were not required to take any other actions in the virtual world. In the study by Toyoda & Harrison (2002), for instance, learners of Japanese were tasked by the researchers with using the text chat feature of Active Worlds 3-D (https://www.activeworlds.com) to engage in free, open-ended, undirected discourse with a native partner that was unrestricted to any particular topic. Studies using Second Life by Wehner et al. (2011) and Liou (2012) also incorporated similar open-ended discourse tasks for learners. In the case of the Wehner et al. study, learners were asked to find and interact with other users in a public area of Second Life (with whom they were previously unacquainted) and then submit chat transcripts to the researchers. Most studies involving open-ended dialog tasks, however, choose to provide learners with a topic of discussion. Studies by Peterson (2005, 2006, 2010, 2012a), Deutschmann & Panichi (2009), Jauregi et al. (2011), DuQuette (2011b), Wang et al. (2012), Wang et al. (2013), Jee (2014), Chen (2016a), Melchor-Couto (2017), and Canto & Jauregi (2017) incorporated tasks in which learners engaged in open-ended discourse centered on particular topics, including the best ways to learn English, ideal marriage partners, personal topics, a flu outbreak, cultural differences, language education in Japan, and preferences for real world vs. virtual world learning, among others. In several of these studies—Peterson (2010), Jauregi et al. (2011), Liou (2012), and Canto & Jauregi (2017)—learners were directed to talk about aspects of the

virtual world itself, although, again, in these tasks the learners were seemingly not required to take action in the virtual world other than engaging in communication.

2.3.2 Presentations and Role-playing Tasks

Similar to tasks involving open-ended dialog on particular topics, another category of tasks that has commonly appeared in studies of virtual worlds in CALL involves role-playing and short presentations. In studies by Deutschmann et al. (2009), Milton et al. (2012), Liang (2012), Henderson et al. (2012), Lan (2015), Chen (2016b), Levak & Son (2016), Yamazaki (2018), Chen & Kent (2020) and Yang, et al. (2022), role-play scenarios were used to cover such situations as workplace self-introductions, ordering food at a restaurant, shopping, and other daily life scenarios. Liang (2012) included tasks involving linguistic play such as verbal poetry duals and poem recitation. Deutschmann and Panichi (2009), Deutschmann et al. (2009), and Peterson (2010; 2012) incorporated tasks involving the delivery of short presentations. Yamazaki (2018) incorporated tasks in a virtual rendition of Tokyo involving taking public transportation, driving on an expressway, and fishing. As with the open dialog tasks, tasks described in these studies involving presentations and role-play scenarios often appear to have primarily made use of the voice or text chat functionality of the virtual world, although these tasks seem to have involved more direct incorporation of the 3D environment into the task design. For example, the role-play tasks described by Henderson et al. and Yang et al. both involved a group of second language learners of Chinese traveling (via their virtual avatars) to an area of Second Life designed to look like a Chinese restaurant. In the case of Henderson et al., learners had to observe an in-world menu and collaboratively decide via text chat on a food order that met certain researcher-imposed constraints, such as choosing food appropriate for vegetarians or people who dislike spicy food.

2.3.3 TASKS WITH NON-LINGUISTIC GOALS

Only 11 of the 34 studies listed in Table 4—Peterson (2006), DuQuette & Hann (2010), Liang (2012), Peterson (2012a), Henderson et al. (2012), Wigham & Chanier (2013), Jee (2014), Chen (2016), Lan et al. (2016), Levak & Son (2016), and Chen & Kent (2020)—incorporate tasks involving definite non-linguistic goals. The study by Liang includes a task where a group of participants look at a visual pattern in the virtual world and try to guess its meaning correctly in order to continue on to other activities. The studies by Peterson (2006) and Jee both incorporated a jigsaw task in which pairs of participants each receive half of a set of pictures depicting a series of events and must then describe the pictures to each other and reconstruct the story line. In the case of the Jee study, the images were provided as physical paper printouts, and the virtual world seems to have been used merely as a communication platform. Four of the studies—DuQuette & Hann, Henderson et al., Chen, and Levak & Son—include street direction giving tasks where one participant studies a route that must then be explained to and followed by a partner. Chen & Kent include a similar maze completion task, where one partner must navigate a maze while receiving instructions from a partner who has an aerial view of the passageways. DuQuette & Hann also include a furniture arrangement task in which one partner directs another to move furniture in a room to achieve a pre-determined arrangement. Chen & Kent included a guided 3D object building task, and finally Peterson (2012a) included a treasure hunt task.

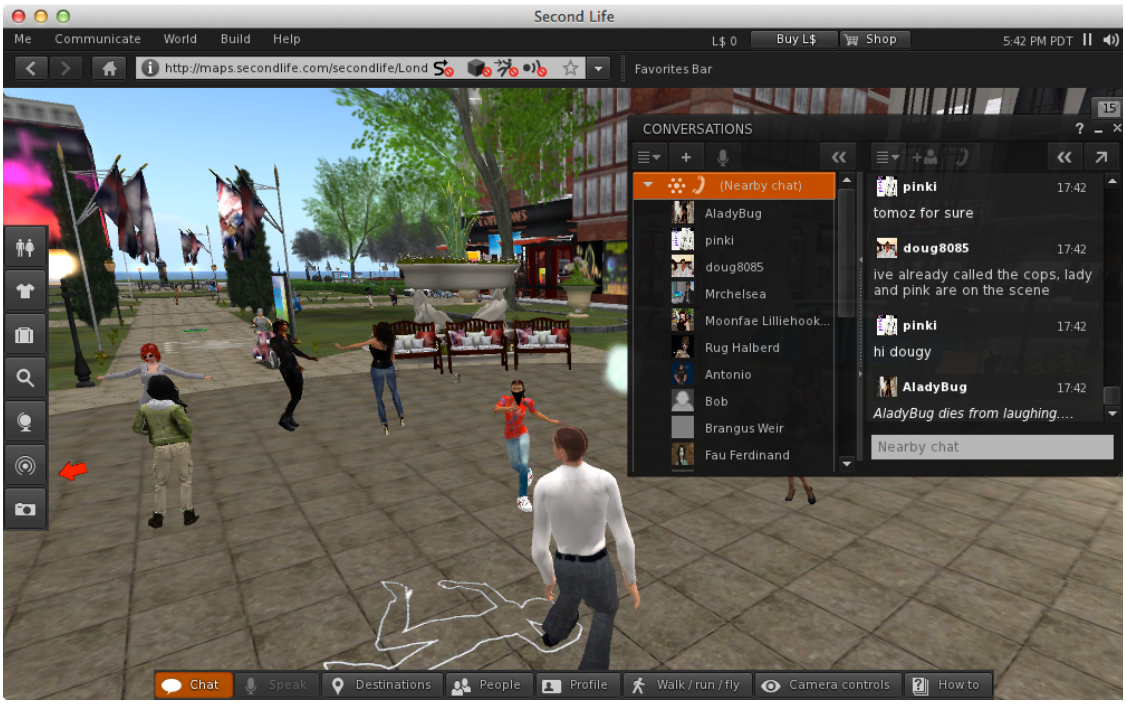
Except for the furniture arrangement task used by DuQuette & Hann and the 3D object building task by Chen & Kent, these tasks featuring non-linguistic goals also seem to have used the virtual world primarily as a platform for voice or text communication, requiring minimal engagement with the 3D environment.

2.4 Factors Affecting Tasks in Virtual Worlds

As mentioned, most tasks in recent studies of virtual worlds have tended to involve participants engaging in various types of open-ended dialogs. Perhaps one factor that has contributed to the abundance of this type of task is the view, expressed by Wehner et al. (2011) and others, that virtual worlds are primarily social spaces. It is thus not necessarily the case that tasks for such spaces will seek to be goal-orientated or even be exploitive of the fact that they are being implemented in a virtual world. Recognition of the social context for learning dates at least to the work of Vygotsky (1978), and has been influential in various frameworks for language acquisition in computer-mediated contexts (Hampel, 2006, 2010; Warschauer, 1997). A clear purpose of many tasks, then, is to promote social interaction among learners or between learners and more competent speakers of the target language.

Still, the lack of task variety given the vast possibilities of virtual worlds may indicate the presence of another factor. All of the studies in Table 4 except for DuQuette and Hann (2011a) appear to have used participants for whom proficiency in the virtual world could not be assumed. In such cases, the platform's learning curve may be significant. Consider Second Life, which is by far the most used platform in virtual world studies. Second Life provides a powerful and highly customizable environment. Such power, however, inevitably leads to complexity. Completing even basic tasks in Second Life, such as moving, chatting, and interacting with objects, requires familiarity with a user interface featuring an extensive system of menus and pop-up controls, as shown in Figure 1. Even in its simplest form, the user interface presents over two-dozen icons and menu items, including information about a custom currency system. Wehner et al. (2011), for example, devote two hours of class time to instructing students in Second Life's most basic operations in order for their participants to complete a simple open-ended free communication task. Completing

Figure 1: Screen shot of Second Life with chat window open

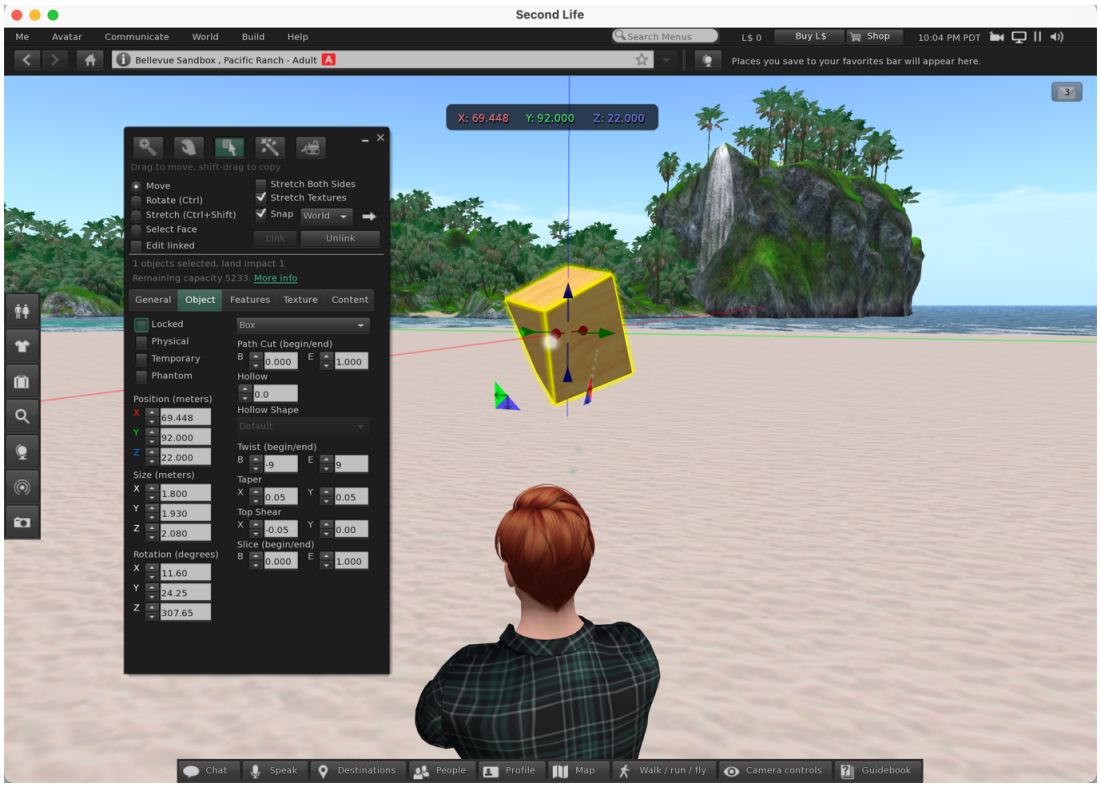


tasks at higher levels of difficulty, such as actually creating objects or modifying the environment, may first require several days of tutorials or other engagement with the platform to gain the necessary expertise (DuQuette, 2011a).

Building in Second Life is indeed a technical endeavor. Figure 2 shows an example of constructing a simple object. Note that the size, shape, and position of the object must be specified by setting values of 20 different numerical parameters, including six parameters that must be set to the thousandth of a virtual meter, and that the six axis guidelines extending out from the object resemble highly technical applications such as computer-aided design (CAD) software. Further, ensuring that user-built elements are kept persistent in the world and are safe from other users requires familiarity with the complicated rules of a virtual real estate market, and possibly the payment of monthly fees to Linden Labs, the developer of Second Life, since Second Life is a commercial product that is restricted to the company's own servers. Creating objects in Second Life that respond to other users or the

environment requires users to script those actions manually using a custom programming language—something that is likely to be beyond the skill and interest of all but the most devoted users. While such power very likely could be used creatively and effectively in SLA contexts, the nearly complete lack of such uses in the literature suggests that for many studies it is simply impractical. It is worth noting that DuQuette and Hann (2010), the only study in Table 4 to include proficient users, was one of only two studies to involve modification of the environment. The other study, by Chen & Kent (2020), used volunteers who specifically expressed an interest in virtual environment language learning. Otherwise, the complexity of advanced operations, particularly in Second Life, appears very likely to have discouraged the investigation of goal-orientated tasks that involve more significant interaction with virtual environments, and instead contributed to the focus on tasks involving open-ended communication.

Figure 2: Screen shot of Second Life showing build tools



There may be benefits for learners in the exploration of more complex tasks. Observing that learning is not inevitable in virtual environments, Milton et al. (2012) have noted that "the challenge for language learning in these environments is to engineer tasks which require learners and native speakers to interact and where a condition of success in the task is the meaningful use of language" (p. 101). Although interaction with a native speaker may not strictly be necessary for learning to occur, and although meaningful use of language may be not so much a condition of success but an emergent requirement of a task's success conditions, the point that task design greatly effects interaction is well taken. As discussed previously, in the substantial literature on the use of tasks in communicative SLA, goal-orientation and gaps in information have been widely seen as key components of task design, in part because they are thought to promote negotiation of meaning (Bygate et al., 2001; Ellis, 2003; Long, 1981). Goals have even been included in the very definition of task, with Bygate et al. writing, "a task is an activity which requires learners to use language, with an emphasis on meaning, to attain an objective" (2001, p. 11). As noted previously, some virtual world studies have included tasks of this type. The DuQuette and Hann (2010) study in particular was further investigating the work of Peterson (2006) on the relationship between task type and level of negotiation in virtual worlds. Peterson was influenced by the work of Blake (2000) and Smith (2003), who made similar investigations using chat software. Each of these studies chose tasks situated within the Pica, et al. (1993) framework. Recall from the previous discussion that in this framework, Pica et al. identify five types of tasks—jigsaw puzzles, exchanging information, solving problems, making decisions, and exchanging opinions—that are expected to promote negotiation of meaning to various degrees, and of all these task types, opinion exchanges and other types of tasks involving open-ended dialog are expected to promote negotiation the least.

2.5 Summary of Literature Review

This literature review has presented strong theoretical arguments and evidence from empirical research studies that the use of communicative tasks in virtual worlds can be beneficial to language learners. This chapter has also presented background work from the field of TBLT on the types of tasks that are thought to promote the greatest amount of beneficial interaction for learners. And last, it has shown that a striking bias exists in the recent literature towards tasks in virtual worlds that are not fully reflective of TLBT theory, due to the steep learning curve of Second Life and other limitations of the platform that make it difficult for average users to modify the environment. As mentioned in the introduction, Minecraft may be a suitable alternative to Second Life for this investigation, and the platform will be introduced in greater detail in the next chapter.

3 INTRODUCTION OF MINECRAFT

It is clear from the previous chapter that there is a need for research on the use of virtual worlds in SLA to consider alternatives to Second Life. This chapter will briefly introduce Minecraft as a potential alternative platform. Features of the Minecraft virtual environment will be described in greater detail in Section 3.1, and Section 3.2 will outline Minecraft's user-friendly design features. The chapter will argue that the design and usability features of Minecraft make it appear highly suited as an arena for task-based language learner interaction. Then, having completed presenting the background on communicative tasks in language learning, virtual world research, and Minecraft as a potential alternative, Section 3.3 will present the specific research agenda for this thesis, to be investigated in subsequent chapters.

3.1 FEATURES OF THE ENVIRONMENT

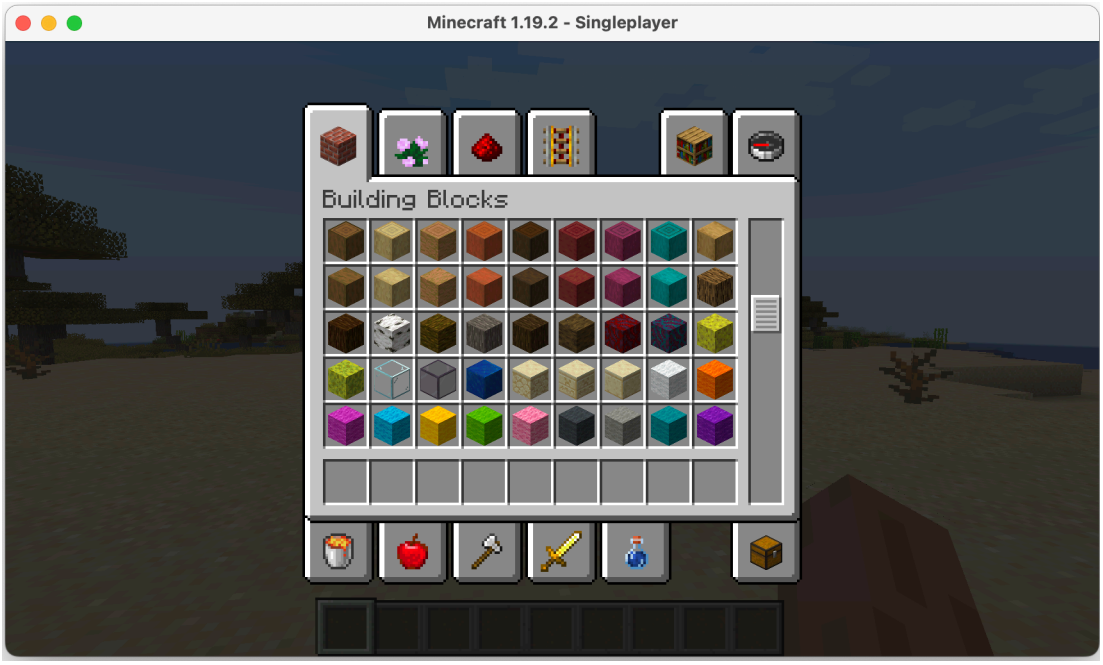
Minecraft is a free-roaming 3D virtual world with optional game elements originally developed by the Swedish studio Mojang AB. The software has been publicly available since 2009, and a full release was issued in 2011. A screenshot of a typical scene is shown in Figure 3, with a few inventory items visible at the bottom of the screen. Although I refer to Minecraft in this study as a virtual world, as noted in Chapter 1, its actual classification is in-between those 3D virtual environments that are clearly games (such as World of Warcraft), and those that are clearly not games, such as Second Life. Minecraft can indeed be construed as a game with a clear purpose: players, working alone or as a group, go about collecting raw materials which can be used to produce more advanced materials and objects such as tools and weapons, while struggling against enemies and hunger in a hostile natural environment until they are eventually able to dispatch the final, most significant enemy (a dragon). However, these objectives are never explicitly stated, and there is no system of points

Figure 3: A screenshot of Minecraft showing items in the user's inventory

or other rewards to guide toward any particular goals, and so any construal of Minecraft as a game is easily ignored or even overlooked entirely by Minecraft users.

Free-roaming worlds (also called "open worlds") such as Minecraft allow the user to explore an environment in an unrestricted and arbitrary way, free from predetermined paths, destinations, and invisible walls. In addition to offering freedom of movement, Minecraft is also a "sandbox", as users are free to both modify the environment and decide for themselves what they would like to do. A typical Minecraft session begins with the creation of a procedurally generated virtual world—that is, a new world created automatically by a partially random computer algorithm. Using normal settings, the world will consist of a massive number of identically sized blocks representing various types of material (rock, minerals, wood, dirt, sand, water, ice, etc.) out of which is formed a vast naturalistic wilderness of mountains, canyons, plains, deserts, forests, caves, oceans, and rivers. The result is a world that has been compared to one made of Lego blocks (Duncan, 2011). And with a mechanic that is not

Figure 4: Screen shot of Minecraft showing various types of building materials



entirely dissimilar to Lego, Minecraft users may collect these blocks of material, carry them, set them down in other locations, and combine them together to form new types of material.

The name *Minecraft* itself is derived from two of these principal actions: *mining*, or collecting material from the natural environment; and *crafting*, or forming new materials from the raw materials. The number of materials that can be created by crafting is very large, and in total Minecraft currently defines over 150 different types of material. Figure 4 shows a screen shot of some of the available materials in the "Building Blocks" menu. Also visible in Figure 4 are tabs for the menus of other material types, such as decoration items, foodstuffs, tools, and combat items (weapons and armor).

Overall, Minecraft's cartoonish and child-friendly aesthetic is in sharp contrast to platforms such as Second Life that attempt a higher degree of graphic realism and in which the environment is almost entirely constructed by hand, rather

than by an algorithm incorporating an element of randomness. The environment of Minecraft also includes weather effects, a day and night cycle, and is populated with various types of hostile and non-hostile creatures, in addition to any playing characters. In this environment, which is typically seen through a first-person perspective, the user has an unhindered ability to set and pursue their own goals, which might consist of exploring, hunting, farming, and building infrastructure.

3.2 USABILITY FEATURES

Minecraft takes the flexibility of this environment much further with the inclusion of four key features. First, there is a "creative" mode in which an individual user is provided with an unlimited supply of all items and materials, as well as immortality and the ability to fly, thus providing the user with a considerable ability to creatively modify the environment. Second, options are available to control the type of worlds that can be generated. So, in addition to the standard naturalistic world, it is possible to create a world that is simply a flat, empty plain of grass which could, for instance, make an excellent canvas for creative building. Third, the standard version of Minecraft allows users to host private virtual environments on their own computers, which can then be opened to other users on a local area network or to the wider internet. This is in sharp contrast to Second Life, World of Warcraft, Active Worlds, and similar platforms that are persistent environments exclusively hosted on commercial servers, and in which the permissions of users to decisively affect the environment are necessarily restricted to protect the environment from abuse. Lastly, Minecraft was originally developed to allow third-party modifications to the software itself, thus allowing the available features to evolve in response to the needs of the user community.

This flexibility in server administration, combined with the ability to randomly generate an arbitrary number of vast worlds, enables Minecraft to

dramatically simplify the process by which users can modify the virtual environment. Instantiations of private Minecraft environments can be treated as disposable—able to be used, modified, reset, and destroyed in any way that suites the preferences of the user (or educator). Perhaps due in part to these qualities, Minecraft has attracted significant interest in its potential applicability for education, seeing use in some form in thousands of schools worldwide (Muffett, 2014). Educators have found the platform useful for teaching a wide variety of subjects, such as basic scientific concepts (Short, 2012), creative writing and literature (Bulkot, 2015; Schifter & Cipollone, 2013), second languages at the elementary and high school levels (Rich, 2016; Uusi-Mäkelä, 2015), and even algorithms for artificial intelligence (Bayliss, 2012). Second language acquisition uses for adult learners have also been explored (Hausrath, 2012; Kuhn & Stevens, 2017; York, 2014).

In collaboration with Mojang AB, the original developer of Minecraft, the firm Teacher Gaming, LLC produced a version of the platform called MinecraftEDU which included a number of enhancements that greatly improved the software's suitability for classroom use (Rich, 2016). Among other changes, MinecraftEDU allowed for researchers and educators to easily develop worlds with a starting state for planned student interaction. Learners could then be allowed to modify the world and the newly modified world could be saved separately and reloaded later. This made it possible to easily manage multiple virtual worlds that had identical starting states, but which had been modified differently by separate groups of learners. In an indication of Minecraft's potential as an arena for educational activities, both Mojang and MinecraftEDU were acquired by Microsoft in 2017 for $2.5 billion. Microsoft has since discontinued MinecraftEDU and instead released its own version of Minecraft for use in schools, titled *Minecraft: Education Edition* (Levin, 2016), which incorporates and expands upon MinecraftEDU's usability improvements. By the end of 2017,

Minecraft: Education Edition had become available worldwide and was reported to have over two million users (Quarnstrom, 2017).

3.3 Research Agenda for This Study

Based on a review of relevant SLA literature and of Minecraft's apparent suitability as a user-manipulatable arena for goal-orientated communicative interaction, several key research questions were identified:

1. **Usability of Minecraft** — *How suitable is Minecraft as an environment for the implementation and completion of goal-orientated communicative tasks in CALL?*
2. **Type and frequency of significant learner interaction** — *What is the nature and frequency of meaningful interaction, such as negotiation of meaning, which is elicited during the completion of goal-oriented communicative tasks in Minecraft?*
3. **Attitudes of learners** — *What are the attitudes of learners towards Minecraft and its use as an arena for task-based learning?*
4. **Attitudes of educators** — *What are the current attitudes of educators towards classroom use of digital games and virtual worlds?*

These questions will be addressed in three phrases, starting with a pilot study described in the next chapter that aims to provide preliminary findings for the first three of these questions. This will be followed by a description of a larger study that will address the first three research questions in greater detail. Finally, a third study will address the attitudes of educators towards classroom use of these methodologies.

4 COMMUNICATIVE TASKS IN MINECRAFT: A PILOT STUDY

This chapter will describe a small pilot study designed to allow for an initial assessment of the suitability of Minecraft as a platform for task-based language learning, particularly in formal educational settings. The chapter will begin with a description of the study's research questions in Section 4.1, followed by an introduction of the study's methodology and three communicative tasks developed for the study in Section 4.2. This is followed by a description of the study's participants (Section 4.3) and procedures (Section 4.4). Section 4.5 summarizes the results of the pilot study. Finally, Section 4.6 discusses lessons learned and how this study influenced the design of a larger follow-up study discussed in the next chapter.

4.1 RESEARCH QUESTIONS

The primary, overall objective in this study is to explore the use, in SLA, of goal-orientated communicative tasks in virtual worlds. The virtual world selected for this study was Minecraft, based on the observations of earlier chapters that Minecraft is likely to provide an environment that is both easy to use and easy to modify. As both the use of Minecraft platform and the use of goal-oriented communicative tasks remain under-represented in the CALL literature on virtual worlds, this exploratory study will adopt a mixed-methods approach in seeking to address the following research questions:

1. How suitable is Minecraft as an environment for goal-orientated communicative tasks? Specifically, to what degree does the platform address the usability issues that have discouraged task variety in other virtual worlds, such as:

a. Does Minecraft realistically allow for the creation and implementation of goal-oriented communicative tasks by teachers?
b. To what degree are novice users of Minecraft, using minimal levels of instruction, able to complete goal-orientated communicative tasks that require modification of the environment?

2. What types of examples of feature-rich interaction, such as negotiation of meaning, are evident in learner dialog generated during the completion of goal-orientated tasks in Minecraft?
3. What are the attitudes of learners towards the use of communicative tasks in Minecraft?

Positive findings for these questions could provide evidence of Minecraft's suitability as an arena for TBLT activities and motivate further investigation. The methodology for the study is discussed in the next section.

4.2 METHODOLOGY

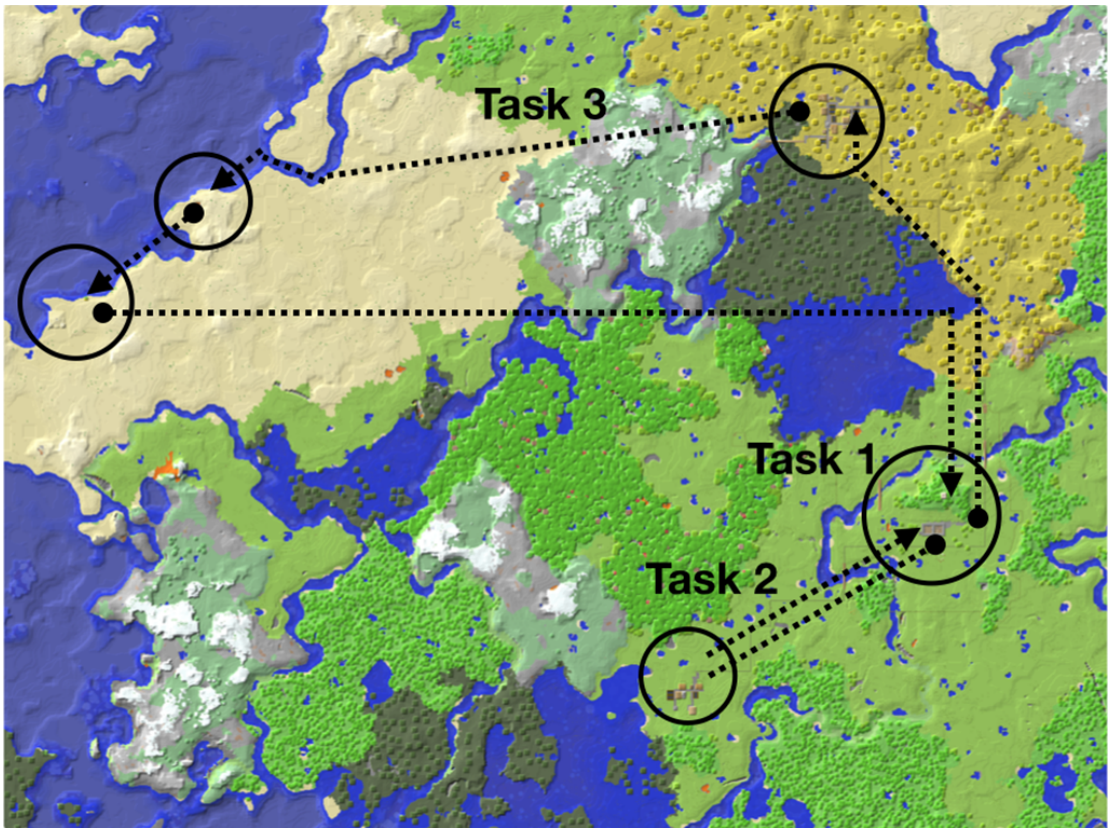
This section will introduce the overall methodology, beginning with a general description of the approach followed by detailed descriptions of three communicative tasks that were developed and tested in Minecraft for this investigation.

To address the stated research questions, the investigation began with the development of three initial cooperative tasks with non-linguistic goals that could be built or implemented by the researcher in a Minecraft environment. These tasks are then tested in Minecraft with volunteer second-language learners, resulting in a record of elicited linguistic interaction that can be subjected to discourse analysis (Gee, 2014) to reveal any occurrences of negotiation of meaning and provide evidence for addressing the second research question, and participant experiences that can be

investigated through interviews and post-study questionaries in order to address the third research question.

The developed tasks are designed to include goals that involve some exploration and modification of the environment, while also remaining suitable for novices who lack experience with Minecraft or similar platforms. Additionally, the tasks are designed to expand beyond open-ended communication and incorporate features seen in the frameworks of Prabhu (1987) and Pica et al. (1993) as being more likely to promote negotiation of meaning. The tasks were also designed to use an unmodified, basic version of Minecraft, thus avoiding any significant infrastructure construction requiring advanced building skills. In particular, the tasks take advantage of the naturalistic structures and environment generated as part of the standard Minecraft world. All three tasks were implemented in the same virtual world and designed for two participants. Figure 5 shows an overview map of the task world, indicating the approximate locations and walking destinations of the three tasks. Blue areas indicate water or ocean, green areas indicate land covered with vegetation (grass or forest), brown areas indicate sand or desert, grey indicates rock or stone, and white areas indicate snow that occurs at high elevations (i.e., mountainous areas). The area covered by the overview is exceptionally large, requiring approximately five minutes to travel horizontally from side to side at Minecraft's normal walking pace, and covering the equivalent of several square kilometers of real-world territory. The origin point (also called a spawn point), where users enter the world, is directly in front of a building where the Task One takes place.

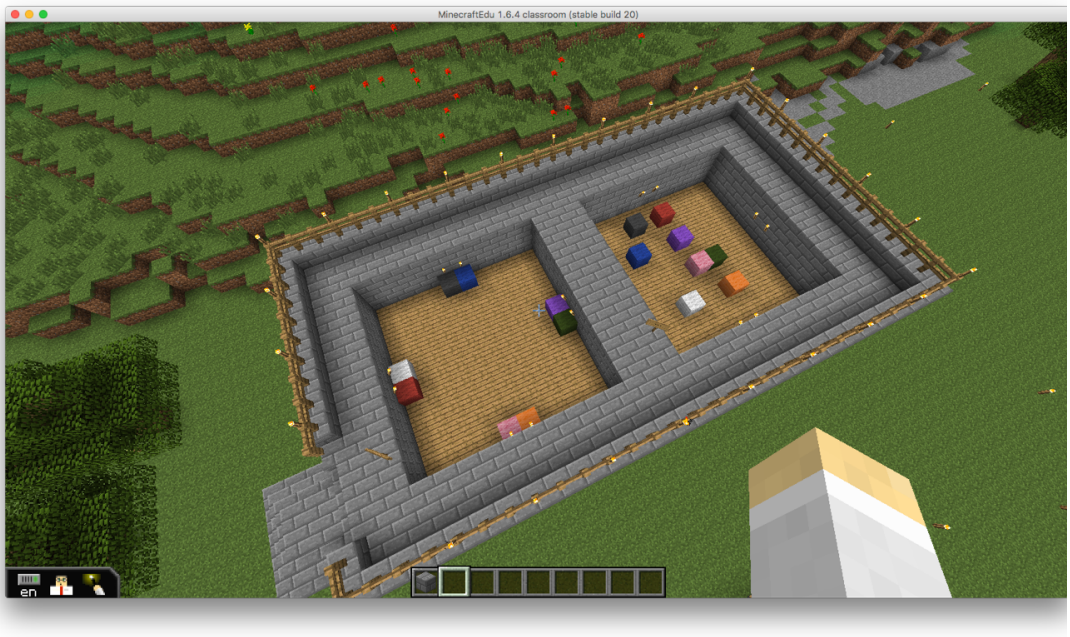
Figure 5: Map showing overview of task world and location for each task



4.2.1 Task One: Classic Information Gap

Task One presents a classic information gap (Prabhu, 1987), and bears some similarity to the furniture arrangement task of DuQuette and Hann (2010). The participants are faced with a building containing two rooms, labeled "A" and "B", as shown in Figure 6. Both rooms contain eight differently colored blocks and are identical except for the arrangement of the blocks. Of the many building materials that could have been used for this task, blocks of colored wool were selected as a material that is easy to work with and which comes in a variety of assorted styles (colors). During the task, one participant takes the role of entering Room B where they are able to move the blocks. The other participant climbs to the top of the building where both rooms are visible through an open roof. The player who can see both rooms must then observe and direct the player in Room B to arrange the blocks so that they are the same as in Room A. The task is complete when both rooms are arranged

Figure 6: Task One, a block arrangement task presenting a classic information gap, showing Room A on the left and Room B on the right



identically. Necessary modification of the environment for the researcher to construct the task involved simply selecting a suitable location and placing stone and wooden fence material to serve as the building itself and placing blocks of colored wool to serve as the colored items in each room. Since this is the first task that the participants would encounter, the building for this task was placed immediately in front of the spawn location, or starting point, for the avatars in the virtual world, so that novice users especially would find it easier to locate the building and begin the task.

4.2.2 Task Two: A Short Journey

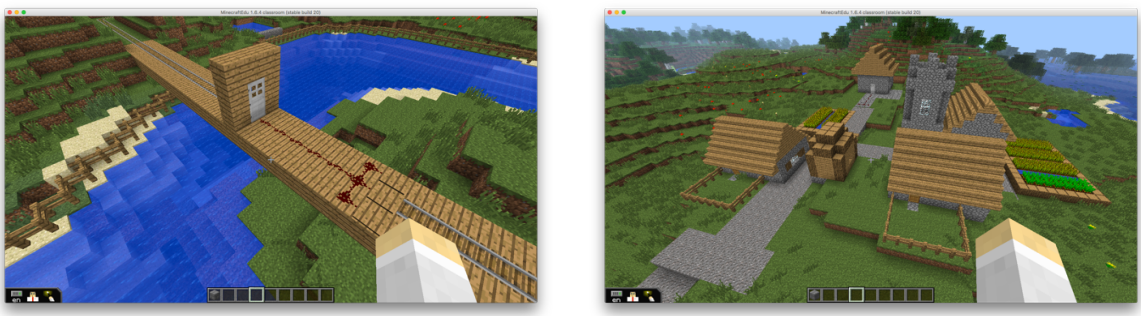
Task Two was developed as preparation for Task Three. The participants are told to find a location called "Fort Wild Horse", which in actuality is a small procedurally generated village a short distance from the spawn location where participants initially enter the virtual environment and where Task One was conducted. The village is shown in the right image of Figure 7, and consists of a few simple buildings, short gravel pathways, and small gardens. The participants must begin the task by

searching the Task One vicinity for a trail with a sign pointing toward the village, then journeying to the village where they must find a chest containing some gold. Once they have located the gold, they must bring it back to the origin point in the Task One area. The participants are told that they must travel together, and along the journey's path there are obstacles and uncertainties which are intended to elicit collaboration and mutual decision-making.

One such obstacle is shown in the left image of Figure 7, where a narrow bridge lacking railings is blocked by a wall with a door in the middle. The door can only be opened by standing on a switch near the red markings on the deck of the bridge. However, if the participant steps off the switch and moves towards the door, the door will close before they arrive. Passing the obstacle requires the pair of participants to realize that one partner must hold the door for the other. On the other side of the door is another switch, allowing the participant who passes through the door first to return the favor by holding the door for their partner. This second switch, however, is not visible until at least one of the partners has passed through the door.

This small puzzle presents a simple reasoning gap, and is intended to promote rich linguistic interaction, including negotiation of meaning. Construction of the task involved locating a nearby village, placing some obstacles as well as a sign and other

Figure 7: Screen captures from Task Two, showing an obstacle in the left image and the destination small town in the right image



material to mark the trail, building the bridge and simple door mechanism, and placing a chest containing some gold in the village.

4.2.3 TASK THREE: A LONG JOURNEY

Task Three is a journey similar to Task Two, however it is much longer and involves the collection of more items. Traveling together, the participants must visit three procedurally generated structures: another small village where they must collect some diamonds, a castle where they must collect some clocks, and a pyramid where they must collect some compasses. After collecting all of the items, the participants must make their way back to the origin point, which again is in the vicinity of Task One. This journey involves several challenges, including some obstacles, and a larger search area to find both the items that need to be collected and the trailheads leading to the next destination. The trails are much longer than in the previous task and in some cases are poorly marked by design in order to create uncertainty and promote collaboration. Participants were asked to stay together, requiring mutual agreement on which direction to travel. Construction of the task involved locating suitable structures on the map, placing the items to be collected, and marking the trail. As the final item to be collected was quite far from the origin, an underground walking tunnel was constructed to provide for a faster and more efficient return trip. Although Minecraft has methods for high-speed transportation, this approach of simply walking through a hidden underground tunnel did not require additional instruction to the participants and was intended to be sufficient as a shortcut back to the origin.

Having selected Minecraft as the target virtual world and constructed three initial communicative tasks, the next step of the pilot study involved recruiting participants, as described in the next section.

4.3 PARTICIPANTS

This research was conducted in Japan, and the three tasks were evaluated with six first or second-year undergraduate students at a national university who were studying English as a second language. All participants were informed volunteers and the first language for all participants was Japanese. The volunteers did not receive any form of compensation.

Table 5: Summary of participants in the pilot study

	Age	**Gender**	**TOEIC Score**	**Gaming Experience?**
Student 1	29	Male	740	Significant
Student 2	19	Male	530	Some
Student 3	20	Female	680	Some
Student 4	20	Female	400	Some
Student 5	20	Female	Not given	Minimal
Student 6	20	Female	650	None

Details of the participants, which were collected via the pre-study questionnaire, are summarized in Table 5. Although this study was not part of any academic program, the participants will be referred to as "students" as this research is of a pedogeological nature. Student 1 was significantly older than the other participants (by approximately 10 years) and had returned to university to change careers. Voluntarily provided TOEIC scores provide an indication of the participants' English proficiency levels, with Students 1, 3, and 6 having intermediate level proficiency, and Students 2 and 4 having basic-level proficiency. Student 5 did not provide a TOEIC score or test score from any standardized English proficiency test, though researcher observation during the session suggested that her proficiency was approximately equal to Student 4. For data collection, the participants were arranged by the researcher in the following pairs: Student 1 with Student 2; Student 3 with Student 4; and Student 5 with Student 6.

The participants were questioned in pre-study questionnaires and interviews about their prior experience with games and virtual worlds. One student reported having no gaming experience, while one student with 'minimal' experience reported having only a few instances of exposure to computer games. Those with 'some' gaming experience (Students 2, 3, and 4) reported having more than a few experiences of playing a variety of games on several different platforms. The student with 'significant' experience reported playing a wide variety of computer games regularly during childhood, though not in recent years. No participant was a regular player of computer games at the time of the study, and all were first-time users of Minecraft. The pre- and post-study questionnaires, which were also used in the subsequent main study, appear as Appendix C and Appendix F respectively. Additionally, each participant was presented with the description of the study shown in Appendix A, and signed the informed consent form shown in Appendix B.

4.4 PROCEDURES

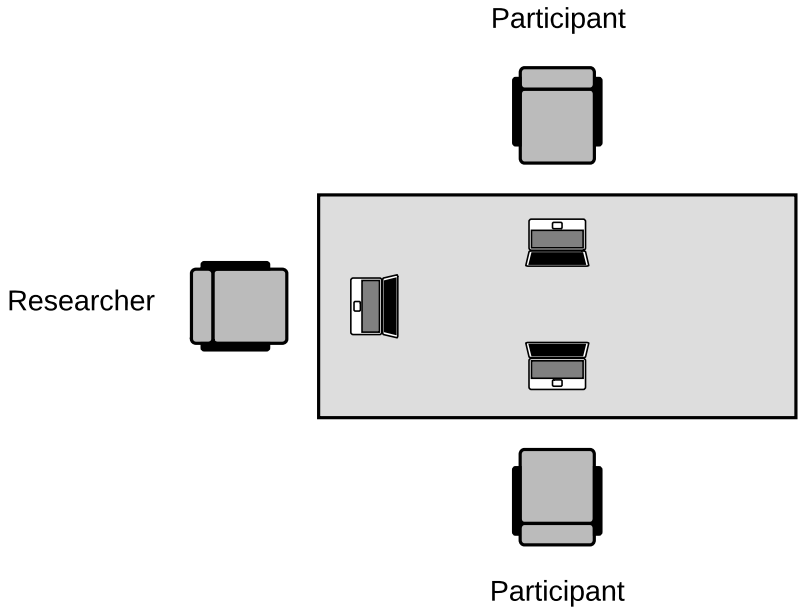
Data collection occurred during a single session for each of the three pairs, lasting approximately two hours, for a total of approximately six hours of data collection. The start state of the virtual environment was identical for each session. In addition to completion of the tasks, the sessions included time to complete the pre- and post-study questionnaires, a Minecraft tutorial lasting approximately 20 minutes, and semi-structured interviews at the end of the session. The tutorial served to introduce the multi-user virtual environment and covered basic operations necessary for completing the tasks, including how to move, jump, climb ladders, collect items, place items, and dig. A screen shot of one section of this tutorial is shown in Figure 8, where users learn to use the space bar to jump over steps and other obstacles. Additionally, the participants were provided by the researcher with the hand-drawn guide to Minecraft keyboard and mouse controls that is shown in Appendix E.

Figure 8: A screen shot of the Minecraft tutorial world showing how to use keyboard controls to navigate obstacles

After the tutorial, the participants were asked to review a document containing brief descriptions of the three tasks and begin Task One when they felt they were ready. After the completion of each task, the participants were asked to move on to the next task until all tasks were completed. All three pairs of participants completed the three tasks in approximately 75 minutes. This session length is comparable to other studies of virtual worlds from Table 4, which generally range from 60 minutes (Toyoda and Harrison (2002), for example), to 90 minutes (Peterson (2005) and others).

As with many games and some virtual worlds, Minecraft has a minimal built-in chat function but does not provide any voice communication functionality, and it is not possible in Minecraft to simultaneously communicate by text and control an avatar in the environment because the keyboard is used to control many basic movements and other operations. In order to allow the participants to communicate freely while also controlling their avatar, the participants were asked to communicate

Figure 9: Seating arrangement used in pilot study



verbally and to restrict their linguistic communication to the target language of English. To facilitate this, the participants were located in the same room and seated directly across from each other at a large table with separate laptop computers facing each participant. The participants could therefore see and speak to each other and see their own computer screens but could not see the other participant's computer screen. The researcher was seated to the side of the same table with a separate computer to host the Minecraft environment. This arrangement is shown in Figure 9.

During the sessions, the researcher also operated an avatar in the virtual environment. The researcher's avatar was set to a separate mode of interaction which allowed it to fly and thus obtain a view of the activities of both participants on the ground from an overhead third-person perspective. Screen capture software was used to record this viewpoint as well as the audio exchanges of the participants via an external microphone. This third avatar mostly remained as a neutral observer but did intervene when necessary. For instance, in one of the sessions an avatar died

accidently during the completion of a task, causing the character to re-spawn at the origin point, far away from the other participant. The researcher's avatar was useful for quickly guiding the re-spawned character back to the current task area so that the task could resume. As interaction between the researcher's avatar and the participants was otherwise kept to a minimum, this was not expected to have a significant impact on the learner interaction and may be comparable to the physical presence of a teacher or researcher in the same room during learner interaction sessions.

After the sessions were completed, the screen and audio recordings were transcribed by the researcher and analyzed for examples of the kinds of interaction that have been identified in the literature as being supportive of language acquisition—particularly negotiation of meaning (Long, 1981; Pica, 1994)—as described in the following section.

4.5 RESULTS

The results of this pilot study will be presented in two parts. Section 4.5.1 will provide examples and analysis of significant participant interaction that was observed during the completion of the three communicative tasks. Section 4.5.2 will provide an analysis of the participant attitudes using data from post-study questionnaires and interviews.

4.5.1 PARTICIPANT INTERACTION

As previously mentioned, the degree to which a task is expected to promote negotiation of meaning has played a particularly prominent role in the evaluation of tasks in the literature. Analysis revealed that such examples were indeed present in the interaction data, and here I analyze three representative examples of negotiation

of meaning from the transcripts to illustrate the target language interaction that was observed.

4.5.1.1 Dealing with an inadequate description

In the exchange shown below labeled Excerpt 1, from Task One, the player who is able to observe the rooms containing the colored blocks is tasked with directing Student 1 in how to arrange the blocks in one of the rooms. In line 3, Student 2 tries to indicate where the red block should be placed, saying "Near the Room A. Side of the pink side… pink side wall." Student 2 is attempting to indicate that the red block should be placed along the wall that is both adjacent to Room A and also close to a previously placed pink block. This description fails to convey the message successfully, and in lines 4–11 the participants progress through a series of negotiations, including: a clarification of the meaning of *pink side* (lines 3–6), and a clarification of the reference point of a directional description (lines 9–11). In line 11, Student 1 is finally successful in indicating which wall should be the new location of the red block, finding a simple and unambiguous description after five attempts and revisions.

Excerpt 1

1	S1:	Next is red and white.
2	S2:	Red and white? Now I have red block.
3	S1:	Near the Room A. **Side of the pink side… pink side wall.**
4	S2:	Pink side wall?
5	S1:	Pink side of wall.
6	S2:	**Do you mean pink block?**
7	S1:	**Yeah. Pink block, this side wall.**
8	S2:	Do you mean this? <*walks to an incorrect location*>
9	S1:	No no no no… **Left… Left wall.**
10	S2:	Left? I don't know which direction you mean.
11	S1:	Uh, sorry. For you, back wall. Back.
12	S2:	Go straight <*S2 reaches the location intended by S1*>
13	S1:	Maybe there you have to put the red box. On the wall.

Although Student 1's final direction of "For you, back wall. Back" may not have been fully grammatical, in this context it served its fundamental communicative goal and appears to have provided Student 1 with a socioculturally valuable experience of understanding his partner's needs and providing a meaningful location-relative description. This exchange also included a clear grammatical improvement, rephrasing the nearly meaningless "side of the pink side" phrase in Line 3 to "pink block, this side wall", which greatly improved the clarity by correctly identifying the object that should be modified by the term "pink".

4.5.1.2 Correcting a misheard term

In the exchange shown in Excerpt 2, from Task Two, the participants have read a description of the task indicating that they must find a village called Fort Wild Horse. In line 2, Student 2 immediately misunderstands *horse* as *house*. The misunderstanding persists until line 9 when Student 1 offers a correction. Student 2

Excerpt 2

1	S1:	So, we have to find where **Fort Wild Horse** is. The town.
2	S2:	**Fort Wild House**…we have to find?
3	S1:	Yes.
4	S2:	I go there.
5	S1:	Yes?
6	S2:	I find…I research there. Where, where…Where, where…
7	S1:	Do you know where it is?
8	S2:	I'm nearby a pond. Mr. Bob? We can't break the…uh…**the house is in the fence?** <*inquiring to the researcher*>
9	S1:	Not "house" but "horse".
10	S2:	Horse?
11	S1:	The name of the town. Look at this. <Refers to printed instructions> "Fort Wild Horse". It's name of the town.
12	S2:	**Ah, I'm sorry. Horse?** <*looks to researcher*>
13	R:	That's just the name of the town.
14	S1:	Yeah. So, we have to find the town.
15	S2:	Town? Maybe we have to go to the high place.

requests clarification of the meaning of *horse* in line 10 by repeating the term. In line 11, Student 1 offers the explanation that "Fort Wild Horse" is the name of the destination town. Still not understanding, Student 2 apologizes in line 12 and asks for clarification from the researcher. The researcher and Student 1 confirm in lines 13-14 that the goal of the task is to find a village named "Fort Wild Horse". In line 15, Student 2 for the first time acknowledges that the goal is to find a town and enhances this success by immediately suggesting a method for locating it (by looking from a high place).

This example of negotiation offered a clear opportunity for the learners to notice pronunciation accuracy and phonetic similarity between "horse" and "house", and both terms were subsequently used correctly and without the need for clarification during the remainder of the session.

4.5.1.3 Resolving a task-level misunderstanding

In the example shown in Excerpt 3, again from Task 1, Student 5 is tasked with checking the target positions of the blocks and instructing Student 6 in how to arrange them. Student 5 seems to begin the exchange not understanding the goal of the task. In line 2, Student 6 explains that Student 5 needs to describe the blocks in Room A but does not specify what attributes are important. In line 3, Student 5 asks about the number of blocks. After Student 6 indicates in line 4 that color is also important, Student 5 provides a full enumeration of the color and number of each block in Room A. Student 6 seems to recognize that this information is not helpful (line 6) but accepts the information and provides a more precise description of the task in line 8, this time indicating that her task is to *move* the blocks. Student 5 continues to misunderstand what information is relevant, and again provides a list of the blocks (line 11). It is not until Student 6 specifically asks about location in line 14, her third attempt at explaining the task, that Student 5 finally understands the goal of the task.

Excerpt 3

1	S5:	How…how do I do?
2	S6:	**You…you should tell me…how blocks…is there in Room A.**
3	S5:	Ah! Okay. Make the number of them?
4	S6:	**And color.**
5	S5:	Color. Black is one. Red is one. Blue is one. Purple is one.
6	S6:	Eh?
7	S5:	Pink is one. Green is one. Orange is one. White is one.
8	S6:	**This is Room B. I will move blocks in this room and I want to know how about Room A.**
9	S5:	How about in Room A? Room A is uh…black…So, the color?
10	S6:	Color?
11	S5:	Ah, okay. Green is one. Purple is one. Orange is one. Pink is one. Red is one. White is one. Black is one. Blue is one. That's all.
12	S6:	**Okay. It's same. Yes…it's same.**
13	S5:	Yes.
14	S6:	**How about place?**
15	S5:	Ah! Ahhh!

This negotiation exchange addresses the socioculturally significant skills of descriptive clarity, as the confusion stems from Student 6's ambiguous and ungrammatical utterance in line 2 of "how blocks…is there in Room A" and is quickly resolved in lines 14 and 15 when Student 6 realizes that she must specify that she is asking about the location of the blocks.

4.5.1.4 Summary of Interaction Analysis

The three examples of negotiation of meaning presented here provide initial evidence that the communicative tasks were functioning in the virtual environment as intended, and that rich opportunities for negotiation were provided by several sources, including planned information gaps (location of blocks in Task One), unplanned phonetic confusion stemming from lexis of Task Two, and the complexity of understanding the task goals themselves in Except 3. Examples of similar instances of negotiation happened for each pair of students on each task, and there were no

tasks that the participants either failed to complete or which did not include negotiation of meaning.

4.5.2 PARTICIPANT ATTITUDES

In order to explore the attitudes of the participants towards completing goal-orientated tasks in Minecraft, they were asked to complete post-session questionnaires and brief semi-structured interviews. The questionnaires included open-ended questions as well as 13 Likert items using a five-point scale: (5) strongly agree, (4) agree, (3) no opinion, (2) disagree, and (1) strongly disagree. The responses to the Likert items are summarized in Table 6. The reader will note that in these questions, Minecraft is referred to as a "game" in order to use common terminology and avoid the need to discuss the technical distinctions between games and virtual

Table 6: Summary of Likert item responses for the pilot study

	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**Mean**
The game was easy to use.	4	4	4	4	2	2	3.3
The tasks and directions were easy to understand.	4	4	4	4	2	4	3.7
Solving the tasks was easy.	4	4	3	3	4	3	3.5
Traditional classes are more useful than playing this game.	2	3	2	3	3	3	2.7
I could learn new words and expressions by playing this game.	4	4	4	4	3	4	3.8
Playing this game cannot help me improve my English ability.	1	2	2	2	3	2	2.0
Most of the discussion was not very useful.	2	2	3	3	3	2	2.5
I could speak and use English successfully during the game.	5	4	4	4	3	4	4.0
There was not much feedback from the other player.	2	2	3	2	2	2	2.2
In the game, I could speak English more freely than in a regular class.	5	5	5	5	4	4	4.7
Using the game was more interesting than a regular class.	5	4	4	4	5	4	4.3
I enjoyed using the game.	5	5	5	5	4	4	4.7
I would like to play this game again in the future.	5	4	4	5	4	4	4.3

Likert scale: (5) strongly agree, (4) agree, (3) no opinion, (2) disagree, and (1) strongly disagree

worlds with the participants. Every participant positively indicated that they did in fact enjoy the session, with the items *I enjoyed using the game* and *I would like to play this game again in the future* receiving mean scores of 4.7 and 4.3 respectively. Additionally, the item *In the game, I could speak English more freely than in a regular class* also received a high mean score of 4.7. Interestingly, although all pairs of participants managed to complete the tasks in the same amount of time, the item *The game was easy to use* received a score of 3.3, with four participants selecting 'agree' and the two participants with the least amount of gaming and computer experience rating the item as 'disagree'. In interviews and responses to the open-ended questions, all participants indicated that they felt communication during the tasks could help improve their English ability and that the session provided opportunities for speaking English and working together. As one participant wrote, "Though we sometimes spoke English incorrectly, we had a lot of chances to practice to speak". Three of the six participants did comment on the length of the tasks and the amount of walking, with one participant noting that there was little to talk about when walking in the tasks involving journeys, saying, "we didn't talk much while we were just waking, I think the time should be shortened". This observation was confirmed by the transcript data, which showed that relatively little linguistic interaction took place at times during the tasks when the participants were not facing an immediate problem or decision point.

4.6 Conclusions on the Pilot Study

This preliminary study sought to investigate the suitability of Minecraft as a virtual environment for the implementation of goal-orientated communicative tasks, and the ways in which such tasks in Minecraft could encourage features of beneficial learner interaction similar to what has been observed in previous studies of learner interaction in virtual worlds.

The first research question addressed issues of usability of Minecraft for both the researcher or teacher, and students or study participants who may be novice users of the platform. Usability issues related to the most commonly studied virtual world, Second Life, were outlined in a previous chapter, and part of the purpose of this investigation was to determine whether Minecraft's usability may be such that it could more easily support the creation and execution of goal-orientated communicative tasks. Results showed that Minecraft does indeed appear to be a suitable platform for developing communicative tasks for language learners. The streamlined interface and block-style simplicity of building in the environment, combined with the ability for users to generate new worlds arbitrarily and maintain independent servers, offered significant advantages over Second Life and other virtual worlds that have been focused on in the existing literature. Three goal-oriented tasks were developed by the researcher with modest effort, requiring the participants to use basic operations to cooperatively explore and modify the environment around them. A short tutorial was found to be sufficient for all three pairs of participants—first-time Minecraft users, some of whom reported having little to no experience with computer games—to complete the tasks successfully and with positive attitudes overall.

The second research question addressed the issue of learner interaction during the completion of the tasks, and the degree to which beneficial features—particularly negotiation of meaning, as this feature has factored prominently in the frameworks for task-based learning—would be present during this interaction. The analysis in the previous section focused on three representative examples of negotiation of meaning, finding that negotiation did occur during the completion of the three tasks, providing evidence that the tasks were functioning as intended. In particular, the analysis found that the combination of Minecraft's particular

environment and the selected communicative tasks elicited communication difficulties both by design, such as in the case of information and reasoning gap tasks, and incidentally, such as the case of correcting a misheard term, and that the participants were able to resolve these issues via negotiation in the target language. Thus, the results presented here are largely in agreement with those reported by Peterson (2006) and DuQuette and Hann (2010), though in this case the users were novices in the platform and yet were still able to achieve an advanced degree of interaction with the virtual environment itself. Additionally, the transcript analysis and feedback from participants indicated that linguistic interaction was decreased during periods in which the participants were not faced with an immediate goal of solving a problem or making a decision, further underscoring the role that explicitly defined goals may play in promoting linguistic interaction.

While it must be emphasized that this pilot study is small—consisting of only a single session with three pairs of participants and three tasks—and that some conclusions were drawn from data self-reported by the participants, which could potentially present issues with reliability, the overall positive results of the study indicated that more research was warranted. Therefore, a study incorporating a larger number of participants working over several sessions was subsequently planned. This larger study, described in following chapters, provided an opportunity to explore a greater variety of goal-orientated tasks and also provided an opportunity to explore ways in which goal-orientated tasks for Minecraft could play a role in SLA classroom contexts.

In designing the main study, several positive elements of the pilot study were carried over, including retaining the methodology of having students use the virtual environment in the same room at the same time and communicating by voice. The Minecraft environment and server software also functioned well and were of course

retained for further investigation. The tasks of the pilot study involving journeys and obstacles functioned well but produced a lower volume of interaction than initially hoped. During longer journeys through the Minecraft landscape, participants were often silent as they were walking together. As a result, this type of task was not included in the main study and instead focus was placed on tasks that had more explicit and significant gaps in information, such as block arrangement tasks, or opinion, such as decision-making tasks like cooperative house building. Finally, it was felt that because the pilot study showed that novice users could quickly learn to use Minecraft, the longer main study could more fully explore creative expression, such as user-built shapes and structures, which might have been difficult to accomplish in a single session with novice users.

The main study is described in two chapters. Chapter 5 presents the methodology and mixed-methods analysis of learner interaction transcripts, and Chapter 6 presents an analysis of feedback from the study participants.

5 TASKS FOR ACTION: THE MAIN STUDY

The results of the pilot study discussed in the previous chapter provided initial evidence that the development of goal-orientated communicative tasks in Minecraft was feasible, that novice Minecraft users could complete such tasks after receiving only basic instruction in the use of the software, and that such tasks could generate feature-rich interaction containing negotiation of meaning. Based on the success of the pilot study, a much larger main study was conducted which expands upon the pilot study by increasing the number of participants, sessions, and tasks, and thus allowing for a more comprehensive evaluation of the research questions. The study will be described in two chapters: Chapter 5 (this chapter) will introduce the study and provide a detailed analysis of language learner interaction based on transcript data and Chapter 6 will describe participant attitudes and feedback based on questionnaires and post-study interviews.

This chapter will begin in Section 5.1 with the specific research questions this study was designed to address. The methodology of the study will be described in Section 5.2, including detailed descriptions of each of five communicative tasks that the study explored. The study participants are described in Section 5.3 and the procedures for data collection are described in Section 5.4. Section 5.5 will present an overview of the collected transcript data, including frequency of negotiation of meaning observed during the interaction for each task. Section 5.6 will present detailed transcript analysis and extensive examples of observed negotiation of meaning. This will provide a basis for answering, in Section 5.7, the first of the three research questions presented in the next section.

5.1 Research Questions

The specific research questions selected for this study include two questions that were partially addressed by the pilot study and which require further investigation, as well as one additional research question regarding the influence of the overall learning environment on the learners' communication strategies.

The two research questions from the pilot study that will continue to be investigated are:

1. What kinds of examples of feature-rich interaction, such as negotiation of meaning, are evident in learner dialog generated during the completion of goal-orientated tasks in Minecraft?
2. What are the attitudes of learners towards the use of communicative tasks in Minecraft?

These questions are central to the research agenda for this thesis and should be investigated with a larger number of participants, a larger number of tasks, and over a longer period of time than was possible with the pilot study.

The third research question pertains to the influence of the learners' overall environment. Whereas the pilot study involved only a single pair of learners and one researcher working in an otherwise unoccupied room, a more realistic scenario for classroom use would involve multiple pairs of learners working simultaneously in a shared physical environment. Consequently, the third research question was selected in order to investigate the effects that such a shared environment may have on communication strategies, as follows:

3. How does a mixed environment, in which pairs of leaners share both physical and virtual space, impact communication strategies of learners during the completion of goal-orientated tasks?

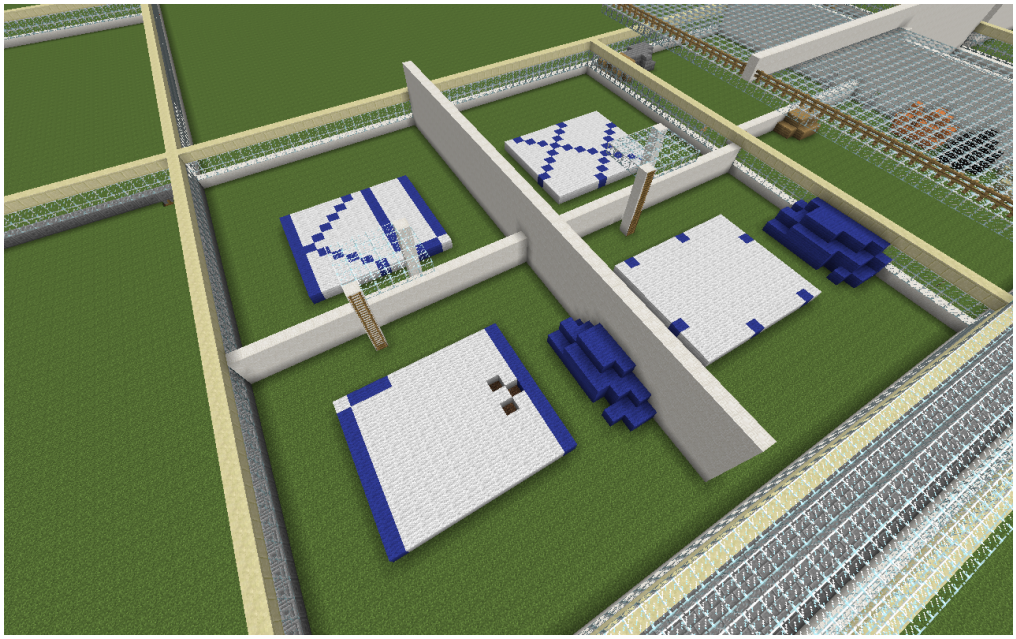
Together, evidence which provides answers to these questions will help to further our understanding of the role that Minecraft and any similar virtual worlds might be able to play in expanding opportunities for task-based communicative interaction in language education programs.

5.2 METHODOLOGY

The general methodological approach for the main study is similar to the pilot study in that learners complete communicative tasks in Minecraft and the resulting interaction is then subjected to careful discourse analysis in order to reveal the presence of negotiation of meaning and other notable features. This analysis provides a basis to address the first and third research questions. Also similar to the pilot study, and in order to address the second research question, the study incorporates a pre- and post-study questionnaire and post-study semi-structured interviews.

The investigation began with the development of five tasks designed to take advantage of the affordances offered by the Minecraft virtual environment, while remaining simple enough for novice users to complete in a single session. All of the tasks were designed to encourage learner autonomy and meaningful interaction while requiring only basic prior arrangements to the environment on the part of the researcher, so as to resemble tasks that would be suitable for use by educators with limited exposure to Minecraft. Similarly to the pilot study, the tasks roughly followed the TBLT framework of Pica et al. (1993)—four of the tasks incorporated a concrete non-linguistic goal that necessitated communicating effectively to bridge a gap in information, while one task (included for the purpose of comparison) incorporated a non-linguistic goal involving collaborative decision-making rather than an information gap. The tasks are summarized in the following subsections.

Figure 10: Starting state for Task One of the main study



5.2.1 Task One: Replicate a Provided Structural Object

The first task was designed as a block arrangement task similar to Task One of the pilot study, but using a larger number of blocks and a more complex arrangement. Working in pairs and in separate walled-off areas of a flat and otherwise featureless version of the Minecraft virtual world, one partner is presented with a simple structural object comprised of two types of materials (blocks of white and blue wool). The structure serves as a target for a second partner—who is provided with the necessary materials—and the goal of the task is for this partner to construct a replica of the target structure without observing it directly, relying only on the directions of the observing partner. The observing partner, who tasked with providing instructions, is able to observe both the target shape and the actions of the partner building the replica. Thus, this task presents a classic one-way information gap. The partners conduct several iterations of this task with different structures and varied materials, switching roles each time. The first two objects to be replicated during this task are shown in Figure 10, near the top of the image. Instructions provided on paper to each

partner at the beginning of the task are shown in Appendix H. The target objects are intended to be simple to conceptualize but challenging to describe precisely. Both of the target objects are comprised of a single layer of blue and white wool arranged to form a square on a flat surface. For one of the shapes, the blue wool is arranged in a pattern resembling the letters “KU”, and in the other shape, the blue wool is arranged in a crisscross pattern. The walled-off areas containing blank squares of white wool are where one of the partners must recreate the target structures. Piles of blue wool can also be observed in these areas, for use by the building partner, as necessary.

5.2.2 Task Two: Crafting and Donning Armor

The second task also involved a classic information gap but explored a more advanced feature of Minecraft called “crafting.” The act of crafting in Minecraft is a process through which certain materials and objects may be created by the user from other preexisting materials. Specifically, the process involves arranging icons, representing diverse types of material, on a three-by-three grid within one of Minecraft's menus according to a particular pattern (or “formula”). An example is shown in Figure 11, where six iron ingots are arranged on the grid in an upside-down ‘U’ shape to create

Figure 11: Minecraft's crafting menu, showing creation of iron leggings

one pair of iron leggings, a type of armor. When the crafting is complete, the iron leggings can be added to the user's inventory, replacing the six iron ingots used in the formula.

Pairs of learners were each provided on paper with a list of crafting formulas for four types of armor (helmet and boots for one partner, and leggings and chestplate for the other) and given the goal of each partner implementing all the crafting formulas that had appeared on either list. The instructions for each partner are shown in Appendix I. On the same instruction sheets, the partners were also separately provided with partial information about how to dress their avatars in the armor they had crafted, creating a secondary information gap. Combining the information on both sheets through communication would provide all information necessary for each partner to outfit their avatars with the armor items. The final goal of the task is for both partners to be wearing a full suit of iron armor. As the partners each possessed key information that needed to be shared with the other, this task involved two-way information gaps.

5.2.3 Task Three: Farming, Crafting, and Replicating a Learner-Constructed Object

Task Three was designed as a follow-up task for the skills that the learners developed in Tasks One and Two, incorporating an increased level of learner autonomy and a one-to-many communication paradigm. The first part of Task Three involved pairs of learners working in a walled off section of a flat Minecraft world where their goal was to create a small wheat farm from which each partner would harvest three pieces of wheat to craft a loaf of bread. An example of a small wheat farm is shown in Figure 12. This part of the task was designed to include a two-way information gap, as one partner was provided with an instruction sheet explaining how to construct a simple

Figure 12: An example wheat farm for Task Three

wheat farm, and the other was provided with the crafting formula to create bread from wheat. These instruction sheets are provided in Appendix J.

The second part of Task Three involved the learners working individually in walled-off sections of a flat world where they constructed their own structures using the Minecraft materials of their choice. Then, each learner, taking their own structure as the target, was tasked with explaining how to build the structure to a small group of other learners (consisting of four or five individuals), with the goal of the other group members each constructing an individual replica of the target structure. Each group member took turns in the explanatory role, and when not in that role, was tasked with building a target structure explained by someone else. Since the work areas were walled off, learners could not directly observe the structures built by other group members and needed to communicate linguistically. Thus, this part of Task Three involved a one-way information gap that was then reversed through turn-taking.

5.2.4 Task Four: Collaborative House Building

For purposes of comparison, Task Four was designed to incorporate a gap in decision making rather than information exchange. In a standard, randomly generated naturalistic Minecraft world, groups of three to four learners worked collaboratively to choose a suitable location after exploring the environment, and then construct a single house in the environment according to their own preferences. This collaborative building activity was designed to require consensus-building and group decision-making. Each group was then asked to give a short tour and explanation of their house to members of the other groups.

5.2.5 Task Five: Scavenger Hunt

The fifth task was designed to incorporate an information gap that, rather than being centered around building and farming as with the previous tasks, was instead centered around a third affordance of Minecraft environment: exploration and gathering materials. Working in pairs, each partner was given a list of ten items to find and collect in the virtual world. Each partner received a different list, yet each partner was tasked with finding all items on either list, thus presenting a two-way information gap and a collaborative scavenger hunt task. The included items were intended to include low-frequency terms for which the learners may not have been familiar, such as *gravel* and *cactus*, but which were also abundant enough in the environment that the learners could locate them in a reasonable amount of time. The full list of items given to each partner is shown in Table 7.

Table 7: List of items for Task Five scavenger hunt

Item list for partner "A"	*Birch wood, cactus, coal, cocoa beans, jungle wood, mushroom, pumpkin, raw porkchop, rose, any yellow flower*
Item list for partner "B"	*Feathers, gravel, oak wood, raw chicken, sand, sandstone, seeds, spruce wood, wheat, wool of any color*

5.3 PARTICIPANTS

For this larger main study, the number of participants was increased to 15 from six in the pilot study. All participants were volunteer students who were enrolled at the same competitive public university in Japan. Details of the participants gathered by self-reporting using pre-study questionnaires are summarized in Table 8. The participants included a roughly even gender balance, with eight male and seven female students. Ages ranged from 19 to 30, with an average age of 22. Twelve of the students were studying at the undergraduate level, while three were graduate students, including student S15 who was a visiting student from a university in Europe. All students were studying subjects related to the social sciences and humanities, and most students were native speakers of Japanese who were born in Japan. The two students who did not originate from Japan were from Singapore and Sweden. Both of these students were observed by the researcher to be advanced speakers of English, with the Singaporean student reporting "Singapore English" as one of her native languages. For the students originating from Japan, English proficiency levels were more mixed. Standardized English proficiency test scores are listed in Table 8 for all participants who reported such scores. Educational Testing Service, the organization that produces both the TOEIC and TOEFL iBT tests, classifies TOEIC scores of 850 or above and TOEFL iBT scores of 88 and above as being in the highest of three proficiency level groupings for each test (Educational Testing Service, 2007, 2014). Four students reported scores at or near that proficiency level, and four students reported more intermediate results. The English proficiency of the five students born in Japan who did not report any standardized test results was revealed thorough observation over the course of the study to be most similar to those students reporting test scores in the intermediate range.

Table 8: Summary of participants in the main study

ID	Age	Gender	Level of Study	Major	Standardized Test Score	Country of Birth	Native Language(s)	Prior Gaming Experience
S1	21	F	Undergrad	Education	TOEIC: 925 TOEFL iBT: 90	Japan	Japanese	Minimal
S2	20	F	Undergrad	Cultural Anthropology	TOEIC: 922 TOEFL iBT: 90	Japan	Japanese	Minimal
S3	19	M	Undergrad	Sociology	None reported	Japan	Japanese	Minimal
S4	20	F	Undergrad	Education	None reported	Japan	Japanese	Minimal
S5	19	M	Undergrad	Linguistics	TOEFL iBT: 84	Japan	Japanese	Significant
S6	21	F	Undergrad	Sociology	None reported	Japan	Japanese	Minimal
S7	23	M	Undergrad	Asian and African Studies	None reported	Japan	Japanese	Significant
S8	30	F	Grad	Linguistics	None reported	Singapore	Hokkien, Mandarin Chinese, Singapore English	Significant
S9	26	F	Grad	Linguistics	TOEIC: 700	Japan	Japanese	Significant
S10	19	M	Undergrad	International Politics	TOEIC: 600	Japan	Japanese	Significant
S11	21	M	Undergrad	Education	TOEIC: 845	Japan	Japanese	Extensive
S12	23	F	Undergrad	Education	None reported	Japan	Japanese	Minimal
S13	20	M	Undergrad	Sociology	TOEIC: 590	Japan	Japanese	Minimal
S14	22	M	Undergrad	Education	TOEIC: 730	Japan	Japanese	Minimal
S15	27	M	Graduate (Visiting)	Japanese	None reported	Sweden	Swedish, Finnish, Japanese	Extensive

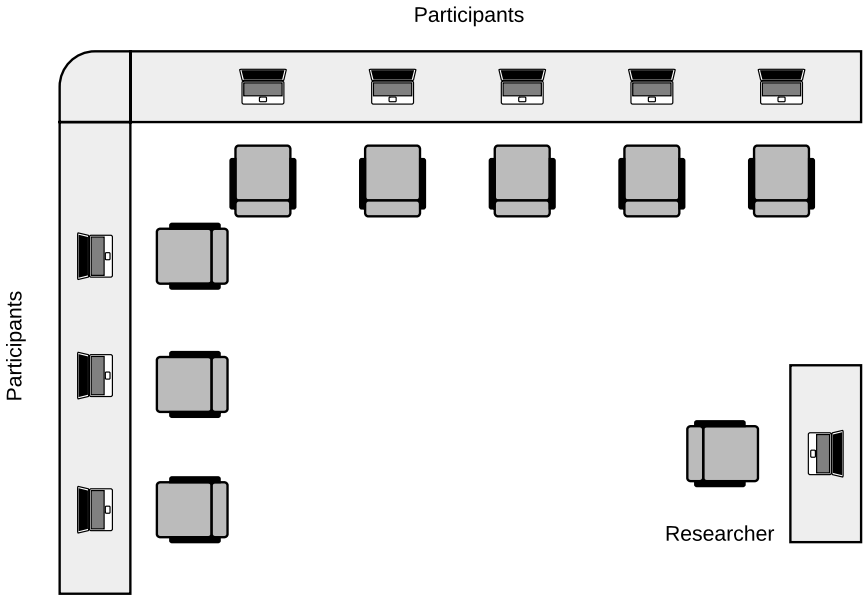
As previous studies on the use of computer games and virtual worlds in second language learning have commented on the role of learner familiarity with the selected computer technologies, Table 8 also reports a three-level categorization of the participants' prior computer gaming experience. The "minimal" label is indicated for participants who reported little to no prior experience with computer games in general, and no prior experience with 3D virtual environments. "Significant" is indicated for participants who reported at least some experience with games incorporating 3D virtual environments, and "extensive" is indicated for participants who reported having a large amount of exposure to multiple digital games incorporating 3D environments across multiple hardware platforms. As can be seen, only two of the 15 participants had "extensive" experience, while five participants have "significant" prior experience and eight had "minimal" experience. None of participants had substantial prior experience with any version of Minecraft.

5.4 PROCEDURES AND DATA COLLECTION

The data for this study was conducted over 13 sessions of 90 minutes each, meeting approximately once per week over a four-month period at a university in Japan using the 15 volunteer students described in the previous section. As with the pilot study, the virtual world platform of choice was MinecraftEDU, a version of Minecraft augmented with features to make it more convenient to use in educational settings than the standard version of Minecraft.

The space available to conduct the study was a small university laboratory that could accommodate approximately eight participants at a time. As shown in Figure 13, eight laptop computers were arranged in a row on an "L" shaped table, with a ninth computer on a nearby table to function as the virtual world server and login terminal for the researcher. With this setup, it was expected that the participants would be able to interact in both the real and virtual spaces. Overall, this

Figure 13: Seating arrangement for main study



arrangement may be more reflective of what is possible in typical institutional language courses, in which most learners can be expected to be present in the same physical location at the same time, than with the fully online scenarios used most virtual world studies.

Due to the space limitations, the 15 participants were divided randomly into a group of eight students ("Group A") and a group of seven students ("Group B"). Each group met separately on alternate weeks but completed the same set of tasks in the same order. Due to infrequent absences or scheduling conflicts, some participants occasionally met with a group other than the one they were originally assigned to. The participants worked together in pairs, though groups of three were occasionally necessary.

Generally, studies of virtual worlds and other platforms that provide for computer-mediated interaction emphasize the opportunities for long distance

interaction as being one of the key affordances of these systems (e.g., Toyoda & Harrison (2002)), and even studies that have investigated the use of such systems by learners physically present in the same room generally take steps to confine interaction to the digital medium (e.g., Peterson (2006)). However, given the space limitations and the number of participants, full physical separation between communication partners was impractical. Instead, the seating was arranged so that learners in the same dyad were seated in non-adjacent positions, and thus could not easily see their partner's papers or computer screens. For the purpose of data collection and to facilitate communication between paired non-adjacent learners, TeamSpeak3 (https://www.teamspeak.com/) voice communication software was used, which allowed each pair of interlocutors to be assigned a dedicated communication channel which could be recorded and later transcribed manually. The learners wore headsets consisting of headphones and a microphone. Although MinecraftEDU as well as the standard version of Minecraft both provide a text chat feature, since the keyboard is also used to control the avatar, it is not possible to use the chat feature while also acting in the virtual environment. By using supplemental voice communication software, the learners were able to communicate freely without disrupting their ability to act in the virtual space.

The full list of data collection sessions is shown in Table 9. Data collection began with an informational session for all participants. During this session, the participants were provided with basic information about the study and the researcher (Appendix A) and reviewed and signed informed consent forms (Appendix B). The first session also included the completion of pre-study questionaries (Appendix C).

As none of the participants were experienced with Minecraft, and some had little experience with computer games and virtual worlds in general, the second session for each group of participants (shown as Session 2 and Session 3 in Table 9)

Table 9: Data collection sessions for main study

	Participants	Activity
Session 1	All Participants	Explanation of study, informed consent, pre-study questionnaire
Session 2	Group A	Minecraft tutorial
Session 3	Group B	Minecraft tutorial
Session 4	Group A	Task One
Session 5	Group B	Task One
Session 6	Group A	Task Two
Session 7	Group B	Task Two
Session 8	Group A	Task Three
Session 9	Group B	Task Three
Session 10	Group A	Task Four
Session 11	Group B	Task Four
Session 12	Group A	Task Five, post-study questionnaire
Session 13	Group B	Task Five, post-study questionnaire

was devoted to completing activities in a tutorial world that was distributed as part of the MinecraftEDU package. As with the pilot study, the tutorial world provided a basic introduction the mechanics of Minecraft, including how to move, jump, and swim; how to navigate obstacles such as ladders, doors, and flowing water; how to use tools; how to deal with the physical properties of various kinds of material; and how to approach Minecraft with a sense of wonder, discovery, and individual agency.

After the tutorial sessions were completed, the following eight sessions were devoted to completing Tasks One, Two, Three and Four with each of the two groups of participants, with each session being devoted fully to a single task with a single group. The final sessions for each group (Sessions 12 and 13) were devoted to completing Task Five and the post-study questionnaires.

5.5 Overview of Collected Data

After the data collection sessions were completed, the researcher reviewed and manually transcribed audio recordings of the sessions. This section will briefly review some of the key statistics of the collected interaction data, which are summarized in Table 10. Section 5.5.1 will provide an overview of the volume of linguistic interaction generated by each task, and Section 5.5.2 will describe the frequency of negotiation of meaning observed for each task.

Table 10: Summary of collected task data

	Task One	**Task Two**	**Task Three**	**Task Four**	**Task Five**
Description	*Object replication*	*Crafting*	*Farming, crafting, object replication*	*Collaborative building*	*Scavenger hunt*
Task Type	2-way information gap	2-way information gap	2-way information gap	Decision making	2-way information gap
Completion rate	100%	100%	100%	100%	100%
Avg. time to complete task	72 min.	80 min.	74 min.	84 min.	54 min.
Avg num. participants per group	2	2	5.5	2.25	2.25
Avg. turns per participant	288	271	74	116	149
Avg. turn length (words)	6.8	7.1	5.9	4.3	3.8
Avg num. of negotiations of meaning	43.2	39.6	34.7	8.4	32.3

5.5.1 VOLUME OF LINGUISTIC INTERACTION

A substantial amount of linguistic interaction in the target language was generated by each of the communicative tasks, as shown in Table 10. The first observation to make about these results is that all partner groups were able to complete all tasks through target language interaction. Tasks One, Two, Three, and Five involved objective goals that all groups were able to achieve. Task Four, in which the participants collaborated on building a house together, did not involve a definitive endpoint, but all groups were able to produce a structure that resembled a completed house. All five tasks were designed to be complex enough to require communication and collaborative interaction to be completed, but not be so challenging that participants would fail to complete them. At a minimum, the completion rate of 100% indicates that the tasks were not excessively challenging for the participants.

Table 10 also shows the average length of time required for participants to complete each task. Each data collection session was intended to last for 90 minutes, and the completion times indicate that the tasks were complicated enough that most of this time was indeed needed, but not so complicated that a limit of 90 minutes imposed a constraint. It is interesting to note that Task Four, which was the only task that did not involve a clearly defined end goal, had the highest average completion time, perhaps because participants simply kept working together on building their structures as long as time allowed. The average completion time of 54 minutes for Task Five, which was the shortest of all tasks, is reflective of additional encouragement from the researcher for the participants to work efficiently, as the sessions for Task Five were also used for completion of post-study questionnaires.

Task One and Task Two generated the greatest total volume of linguistic output of all the tasks, due to the complexity of the tasks and the precise communication necessary to achieve the goals. These tasks generated both the highest

average number of speaking turns per participant, and the highest average number of words spoken per turn. Since all participant groups consisted of only two members for the first two tasks, opportunities for communication may have been maximized. The larger group sizes of Task Three led to a lower average number of speaking turns per participant, down to 74 from an average above 270 for Tasks One and Two. For Tasks Four and Five, the average number of turns per participant were 116 and 149 respectively, which may reflect the small group sizes but also a possibly lower degree of task complexity compared to Tasks One and Two. Tasks Four and Five also had the shortest average turn lengths, which may also be indicative of reduced complexity compared to the other tasks.

5.5.2 Frequency of Negotiation of Meaning

Although some variance in the level of linguistic output was observed between the tasks, all five tasks produced a plentiful amount of linguistic interaction in the target language. But as mentioned previously, SLA researchers view interaction that features negotiation of meaning to be particularly beneficial for language learners. Following the framework of Pica (1994) and Long (1996), the collected data was annotated by the researcher for five types of negotiation strategies: listener requests for the speaker to make a clarification, speaker requests for the listener to confirm understanding, repetition of an utterance, elaboration of an utterance, and rephrasing an utterance in a simpler way.

Almost all of the observed negotiation of meaning, across all tasks and groups, followed a similar pattern: the speaker would make an utterance, the listener would request a clarification of the meaning, and the speaker would respond by repeating or rephrasing the initial utterance. Although in these interaction patterns both the speaker and listener are actively using strategies to arrive at a shared understanding of an utterance's meaning, for the purpose of this analysis such interaction was

counted as a single instance of negotiation, even if unfolded over more than one speaking turn.

As can be seen in Table 10, a substantial amount of negotiation was observed. Similar to the results pertaining to the volume of interaction, Task One and Task Two also showed the greatest amount of negotiation, with an average of around 40 instances for each group of partners. A slightly less but still considerable amount of negotiation was observed in Tasks Three and Five. Task Four, which is the only task that did not involve a two-way information gap, produced the least amount of negotiation, averaging 8.4 instances per group of partners. These results are consistent with Prabhu (1987) and subsequent work on TBLT theory that suggests information gap tasks produce more negotiation than opinion gap tasks, such as those involving decision-making. These results additionally suggest that the communicative tasks were functioning in the virtual environment as intended. In the next section, selected examples of negotiation will be analyzed in greater detail before considering other significant types of interaction that may have arisen during the data collection sessions.

5.6 Analysis of Negotiation of Meaning

The discourse analysis in this section will be focused on evidence that the communicative tasks described above have functioned as intended and have effectively elicited meaningful interaction, as well as in evidence of meaningful interaction that spanned both the virtual and physical spaces shared by the learners. In the following sections, I will present examples of both of these kinds of interaction. For the learners, however, tasks and available spaces (either virtual or physical) comprise only part of an overall ecology of factors that influence motivations and opportunities for meaningful language use. Consequently, the analysis will also consider examples of interaction that relate to the learning environment as a whole.

The analysis will begin in the next section with examples of interaction focused on the maintenance of intersubjectivity.

5.6.1 INTERACTION FOCUSED ON INTERSUBJECTIVITY

As mentioned in Chapter 3, negotiation of meaning between language learners does not always center around clear deficiencies in lexical or grammatical knowledge, and strategies of negotiation also play a role in helping to establish and maintain intersubjectivity even in cases where a breakdown in communication has not necessarily occurred. This section will discuss four examples of this type of interaction.

Excerpt 4

1	S4	Okay, first of all, I think you have to collect enough boxes. The orange ones and black ones.
2	S6	Orange and black? ***<Clarification request>***
3	S4	Uh, yes. ***<Confirmation>*** You have to collect each twenty-five.
4	S6	Twenty-five? ***<Clarification request>***
5	S4	Yes. Twenty-five for each, so fifty in total. ***<Elaboration>***
6	S6	Okay.

In the first example, shown in Excerpt 4, from Task One, students S4 and S6 are completing an object replication task. S4 is acting in the role of the director and can see both the target shape and the shape that S6 is building. S6 is acting in the role of the builder and is tasked with following S6's directions to construct a copy of the unseen target shape. In line 1, S4 directs her partner to collect orange and black *boxes* (actually cubic blocks of colored wool). S6 responds with a clarification request in line 2, confirming the colors of blocks to be collected. This clarification may have been motivated in part by the grammatically marked usage of *ones* in line 1, but it is also likely that S6 intended the clarification to simply reassure S4 that the essential information regarding the block colors was received correctly. S4 confirms the information in line 3 and adds the additional information that S6 will need to collect

25 of each color, using the slightly ungrammatical phrase *collect each twenty-five*. Using the same strategy as in line 2, S6 signals her attention and understanding of this key piece of information in line 4 by requesting a clarification, which S4 takes as an opportunity to rephrase and elaborate on her previous utterance, saying in line 5 *twenty-five for each, so fifty in total*. Note that S4 has now produced a significantly more grammatical and informative utterance, to which S6 finally signals her comprehension of in line 6.

Excerpt 5

1	S10	Ah… sorry. How many floor will we make? One?
2	S13	Two?
3	S10	Two? ***<Clarification request>***
4	S13	Two.
5		Or, make a… only one, and make another house on to the tree next to each other?
6	S10	So… we make only one floor and then connect? ***<Clarification request>***
7	S13	Haha, okay?
8	S10	Okay.

The second example, shown in Excerpt 5, comes from Task Four, in which the participants were asked to cooperatively build a house in the virtual environment using whatever designs and materials they found suitable.

In line 1, S10 asks his partner how many floors the house should have and effectively suggests that it should have only a single floor. In line 2, S13 acknowledges that he understood the suggestion with a contextually appropriate suggestion of his own that it should have two floors instead. S10 responds in line 3 with a request to clarify that S13 is suggesting two floors instead of one, attempting to signal that he simply understood the suggestion without explicitly agreeing to it. S13 confirms the suggestion in line 4, but lacking a signal of agreement from his partner, then adds in line 5 a compromise suggestion that they instead build two single floor structures (one of which will be in a tree). In line 6, S10 again makes a clarification request, this time

to indicate understanding of the proposal to build two structures, and to ask if S13 intended for them to be connected. S13 effectively agrees or confirms that this is his plan in line 7, by asking if S10 agrees to it. S10 then confirms his agreement in line 8.

The third example, in Except 6, is also from Task Four, and shows a typical use of a confirmation request and a repetition response to maintain intersubjectivity.

Excerpt 6

1	S9	How about using jungle wood planks for outer walls?
2	S12	Jungle wood planks? ***<Clarification request>***
3	S9	Jungle wood planks. ***<Repetition>***
4	S12	Uh, where…where?
5	S9	It's in "building blocks" section…
6	S12	Yes…
7	S9	And second from the right side, on the top.
8	S12	Ah okay!

S9 begins in line 1 by suggesting the use of jungle wood planks (a common Minecraft material) to construct a part of the structure the partners are building. S12 signals attention and confirms that she heard the term correctly by making a clarification request in line 2. Since Minecraft has over 150 different types of materials, this may be S12's first time encountering the term *jungle wood planks*, and this novelty may have provided an extra incentive for clarifying the term. In line 3, S9 confirms the term through repetition, and in lines 4 through 8 the partners engage in a brief discussion about where to find the item in Minecraft's inventory of materials.

Finally, the fourth example, shown in Excerpt 7, is drawn from the Task Five scavenger hunt. Both birch wood and oak wood were included in the lists of required items. Although the task directions did not provide guidance on how to collect wood, the participants may have learned during previous sessions that breaking the material blocks that form trees in Minecraft is one way to acquire wood. S11 begins

Excerpt 7

1	S11	Let's try to cut down a tree.
2		Okay, I found oak wood. Just cut the tree with the axe.
3	S14	Hmm? You cut the tree? ***<Clarification request>***
5	S11	Yes. With the axe. And that's oak. ***<Rephrase>***
6	S14	Ah.
7		Maybe that's a different kind of tree. What is that?
8		This is… yes, oak wood, yes.
9		Ah, birch wood! This is birch wood.
10	S11	You found birch wood? ***<Clarification request>***
11	S14	Uh, yes. This white tree. <***Confirmation***>
12	S11	Oh, okay. Birch wood.

the excerpt by suggesting to his partner that they look for wood by cutting down some trees. The first tree that S11 tries happens to be an oak tree and S11 is able to collect several blocks of oak wood. He advises his partner to *just cut the tree with the axe* (line 2). In line 3, S14 initiates a clarification, indicating attention and understanding of the procedure to collect the wood. S11 confirms this understanding in line 5 with a positive response and repeating the information about using an axe to do the "cutting." After S14 applies this technique to a white tree rather than to the brown-colored trees that had yielded oak wood, he finds that he has collected birch wood, which is also a target item of the scavenger hunt. This valuable information is then confirmed by S11 with a clarification request in line 10 and response in line 11.

These four examples show that, even when clear communication breakdowns were not evident, the tasks were successful in eliciting complex sociolinguistic interaction and that the participants were led to consider and actively maintain intersubjectivity in order to accomplish the task goals. In the next section, examples of negotiation of meaning will be considered where participants were focused on understanding the tasks themselves.

5.6.2 Negotiation of Participant Roles and Task Understanding

The five tasks considered in this study were designed according to the principles of TBLT to feature non-linguistic goals and a framework that includes purposely designed gaps in information or reasoning in order to elicit meaningful learner interaction. However, the analysis in this section will show that these task goals and designed gaps were themselves were not the only sources of interaction containing negotiation of meaning. In particular, prior to beginning work on completing a task, paired participants were observed interacting in order to reach a shared understanding of the task itself and what their individual roles would be in solving it. This section will examine two such examples.

In the first example, shown in Excerpt 8, participants S9 and S12 are working together for the first time, and are beginning to work on Task One. This is their first time attempting to complete a communicative task in Minecraft. S9 begins by asking her partner the ambiguous question *which do you want?* Not understanding what this may refer to, S12 makes a clarification request in line 2. S9 rephrases the question more clearly in line 3 to indicate that she is referring to the "Partner A" and "Partner B" roles that were specified in the task descriptions. In lines 4 through 7, the partners quickly agree on who will adopt each role, with S9 being the partner responsible for building a replicated shape, and S12 being the partner who can observe the original target shape and instruct her partner on how to build the replica. In line 7, S9 makes an ambiguous reference to an elevated observation platform in the task area that had a glass floor, calling it *the glass something*. Not understanding this reference, S12 again asks for a clarification in line 8, to which S9 responds in line 9 by rephrasing her original utterance as a suggestion for both partners to climb the ladder up to the

Excerpt 8

1	S9	Which do you want?
2	S12	Hmm? ***<Clarification request>***
3	S9	A or B? ***<Rephrase>***
4	S12	Uh, maybe A.
5	S9	Okay, so I'll be B.
6	S12	Okay
7	S9	Okay. Ah, you are already on the glass something? <*Referring to an observation deck with a transparent glass floor*>
8	S12	Ah, I'm sorry? ***<Clarification request>***
9	S9	Oh, maybe we should climb the ladder. ***<Rephrase>***
10	S12	Ah, yes, that's true. Thank you.
11		Ah, I see.
12	S9	So, you see something on the white thing?
13	S12	Yeah, I'll try.
14		Hmm. <*Long pause*>
15		Oh, we, uh, we have to put the blue box onto the white boxes.
16	S9	What? I'm sorry, I couldn't hear you. ***<Clarification request>***
17	S12	Ah, okay. Uh, we have to move the blue box...boxes. ***<Rephrase>***
18	S9	Uh-huh.
19	S12	On to the white boxes.
20	S9	Okay. And I have to make a shape or something with blue boxes?
21	S12	Yeah, yeah.
22	S9	Okay, and you will tell me how to do it, right?
23	S12	So, are you getting blue boxes?
24	S9	Yes... and?
25	S12	Hmm?
26	S9	And I think you have to be on the glass tower, and I'm collecting the blue boxes, and you tell me how to make the shape or something.
27	S12	Okay, okay. Uh, do you know how to put the blue boxes?
28	S9	Uh, oh, I don't know.
29	S12	Ah, okay. I see.
30	S9	Wait, I think you have to be on the tower, and then you will tell me what shape we have to make.

observation platform. In lines 10 to 15, it seems clear that S12 does not yet understand her role in the task or that a gap in information exits, despite S9 asking for direction in line 12. A brief meaning negotiation happens in lines 16 and 17, due possibly to background noise. Still lacking directing from her partner, S9 makes asks for more information in three different ways in lines 20, 22, and 24, before finally giving a

longer explanation in line 26. In lines 27–29, S12 finally seems to realize that an information gap exists, and in line 30, S9 repeats her earlier successful explanation.

In the second example, shown in Excerpt 9 from Task Four, a participant (S3) who did not provide a standardized test score but who was observed to have a lower proficiency level than the other participants, was pared with a more proficient student, S14, who reported a TOEIC score of 730. In the exchange, the participants must work cooperatively to build a house in the virtual environment. The task instructions have been provided entirely in English, and S3 begins the exchange by asking his partner about the goal of the task. In line 2, S14 first repeats S3's ungrammatical *make house* before correcting the phrase to *make a house*. S3 asks for further clarification in lines 3 and 6, inquiring about allowed type of house and the allowed location. (The participants were instructed that they could choose the design and location of the house themselves and were encouraged to first explore the Minecraft environment to find a suitable location.) S3 understands from S14's question in line 7 that they are able to choose the location freely, and seemingly attempts to suggest building the house on top of a mountain but cannot recall the term *mountain*, instead trailing off at the end of line 8. By considering both the context of the conversation and local topography of the virtual environment, S14 makes a clarification request in line 9,

Excerpt 9

1	S3	House.. Make house?
2	S14	Make house. We have to make a house. Place is… everywhere okay.
3	S3	Okay. Hey…. House? Any house okay?
4	S14	Yes.
5	S3	Okay.
6		Place… where we build house?
7	S14	What kind of place do you want?
8	S3	I would like to… top of the…
9	S14	…top of the… mountain? ***<Clarification request>***
10	S3	Mountain, okay. ***<Scaffolding>***

suggesting the term *mountain*. In line 10, S3 agrees and repeats the term in a probable instance of scaffolding.

As these examples show, opportunities for meaningful interaction began even before the participants started to engage the specific goals of each task. Initial interactions between the participants to develop a shared understanding of the task itself and the roles the participants would take in the interaction also provided opportunities for negotiation of meaning.

5.6.3 Interaction Arising Directly from Task Goals

This section will consider six examples of in which the goals of the tasks and the gaps in information or decision-making appear to have had their intended effect of eliciting target language interaction that contained negotiation of meaning. The analysis will begin with three short examples from Task One, and then will discuss one extended example from Task Three, and two examples from Task Four.

The three examples from Task One are shown in Excerpts 10, 11, and 12. Each contains a single instance of negotiation of meaning. In Excerpt 10, S1 and S2 are discussing the placement of blocks of colored wool in the shape replication task, where S2 is tasked with following S1's directions and constructing a replica of a shape that is only observable to S1. S2 has placed a block of wool and S1, who is observing from a distance, begins in line 1 with *I'm not sure this place is correct or not*. While the meaning is clear, note that the usage of *this place* is grammatically marked in this instance because the point of reference is distant from the speaker, and *that place*

Excerpt 10

1	S1	I'm not sure this place is correct or not.
2	S2	What? ***<Clarification request>***
3	S1	I'm not sure the place is correct or not. ***<Repetition, correction>***
4	S2	Ah, okay.

would have been a more natural reference. S2 does not hear the utterance clearly and asks for a clarification in line 2. This provides S1 with an opportunity to notice the error and repeat the utterance, this time self-correcting the determiner from *this* to *the*. Since only one location is salient in this context, the definite article *the* is also grammatically acceptable and a clear improvement over the original utterance.

Excerpt 11

1	S5	And what do we have to do now?
2	S7	Put the box to the middle.
3	S5	In the middle? ***<Clarification request>***
4	S7	Yeah, maybe here?

Excerpt 11 shows a similar grammatical correction in which S5, who is constructing the replica shape at the direction of S7, asks about the next step in the process. S7 responds in line 2 with the utterance *put the box to the middle*, using *box* to refer to the cubic blocks of wool out of which the shape is being constructed, and making the grammatically marked preposition choice of *to the middle*. S5, noting the grammatical issue, makes a clarification request in line 3 that corrects the grammar to *in the middle*. S7 accepts the correction and agrees in line 4, suggesting that S4's current location is where the next block should be placed.

And finally for the examples from Task One, Excerpt 12 shows an exchange in which participants deal with an unknown word. S11 is directing S6 on how to build the target shape and begins the exchange by indicating that the completed shape should be symmetrical. S6 appears unsure of the meaning of *symmetry* in line 2. The

Excerpt 12

1	S11	We have to make, uh, symmetry.
2	S6	What? Symmetry? ***<Clarification request>***
3	S11	So both sides are same. ***<Elaboration>***
4	S6	Like this? *<Begins completing the shape symmetrically>*
5	S11	Yes, right.

explanation in line 3, that both sides should be the same, does not by itself communicate the full meaning of *symmetry*, but combined with the context of the partially built shape and knowledge of the task, S6 is able to infer the correct meaning, which is immediately grounded in the concrete action of actually building a symmetrical object. S11, observing his partner's actions in the virtual world, sees that her understanding is correct and provides a supportive and affirmative response in line 5.

The example from Task Three, shown in Excerpt 13, an exchange occurs in which the partners must negotiate the meaning of *five by five* and settle upon appropriate terminology for describing a shape which S2 created and is describing to S4. S2 is explaining how to place blocks of white wool, and in line 1 explains that the

Excerpt 13

1	S2	Okay, so, please escape from there. And firstly, we are using 25 white wool, and please make that square of five by five, on the first floor. Let's say first floor. ***<Elaboration>***
2		Okay, so, this building will have three floors at the end. Please let me know if you have finished.
3	S4	Excuse me.
4	S2	Yes?
5	S4	Five five five? We use? ***<Clarification request>***
6	S2	Five BY Five, I wanted to say. So, I think it's twenty-five in total. ***<Repetition, elaboration>***
7	S4	Twenty-five? We have eight… How… how? ***<Clarification request>***
8	S2	Hmm? ***<Clarification request>***
9	S4	How many wool we use?
10	S2	Ah, we are using 25 white yuu… white wool.
11	S4	Five five… Five stairs? Ah, one stairs? One stair? ***<Clarification request>***
12	S2	Yes. Get it? Have you got it? So, you are making a square, only in the first floor… ***<Elaboration>***
13	S4	One floor. Oh, okay.
14	S2	Okay.

wool should be arranged in a *square of five by five*. In line 1, S2 also uses the term *first floor* to refer to the first level of blocks that comprise the shape. She appears to know that this terminology is unusual, and with an awareness of the importance of intersubjectivity, explicitly attempts to develop a shared agreement with her partners to use the term *floor* to refer to these levels. In line 5, S4 makes a clarification request, having misheard *five by five* as *five five five*. Despite a clear description by S2 in line 6 involving both repetition of the term and elaboration of the meaning, confusion persists until line 11 were S4 again repeats the term *five* and appears to wonder whether the shape should have one level or five levels of white wool, incorrectly using the term *stairs*. Confirming the number of levels in line 12, S2 again uses the term *floor*, which is a more accurate term in the context of the target shape, despite still being a marked usage. Scaffolding is complete when S4 adopts the term *floor* in line 13. Inspection of the final shape revealed that S4 also successfully constructed the five-by-five layer of white wool blocks, understanding from context and S2's description of *five by five* as a square with 25 blocks what the target shape should look like.

The final two examples come from Task Five, the scavenger hunt task. Both examples are of scaffolding, where one member of a pair of participants learns the meaning of a previously unknown term for a necessary scavenger hunt item from another member. In the first example, shown in Excerpt 14, the term *cactus* is initially known to S1, but unknown to S4. As can be seen in the exchange, S1 begins by informing her partner that they will need to collect cactus, as it is one of the scavenger hunt items on S1's list. Recall that each partner has a different list, so the item does not appear on the list provided to S4. Not knowing the term, S4 asks for a clarification in line 2. In line 5, S1 indicates that it is something that can be found in the desert. This elicits another clarification request from S4 in line 6, prompting S1 to rephrase

Excerpt 14

1	S1	We need cactus.
2	S4	Yeah… Do you know what the cactus is? ***<Clarification request>***
3	S1	Cactus is…
4	S4	I don't know the cactus…
5	S1	It's in the desert. ***<Elaboration>***
6	S4	Desert? ***<Clarification request>***
7	S1	You can find it in a hot place. ***<Rephrase>***
8	S4	A hot place? Ah, okay. ***<Clarification request>***
9	S1	It has a lot of needle… ***<Elaboration>***
10	S4	Needle? ***<Clarification request>***
11	S1	In the skin. ***<Elaboration>***
12	S4	That's a animal? ***<Clarification request>***
13	S1	No… plants. ***<Elaboration>***
14	S4	Plant. ***<Repetition>***
15	S1	Many needle. ***<Repetition>***
16	S4	Really? Sounds dangerous.
17	S1	Let's go to the desert area.
18	S4	Yeah.
19	S1	Ah, I found cactus.
20	S4	Cactus! Oh really? Ahhh… This is cactus. I got it!
21	S4	You got it? ***<Clarification request>***
22	S1	Yes.

desert as *a hot place* in line 7. This is followed by another clarification request in line 8 and elaboration from S1 in line 9 that cactus is something that has *a lot of needle*. The term *needle*, which is a reference to the spines of a cactus, also prompts a clarification request to which S1 elaborates that the needles are *in the skin*. This leads S4 to ask whether *cactus* is an animal in line 12 (mistaking the reference to skin as being the skin of an animal) prompting S1 to add the elaboration that cactus is a type of plant. In lines 17 to 19, the partners travel to a desert biome area in the virtual world, and S1 finds a cactus immediately. Since the partners traveled together as part of the task, S4 could see the plant from which S1 harvested the cactus. In line 20, S4 finally comes to understand the term herself, making an authentic discovery of the virtual plant.

The final example, shown in Excerpt 15, is similar to the one above. The learners are searching the Minecraft virtual environment for the scavenger hunt item "gravel" but S7 does not understand the meaning of the term. S3 begins the exchange by announcing that he has found gravel in line 1. S7 asks for a clarification in line 2 but does not explicitly indicate that he does not understand the term. S3 affirms that he is referring to gravel in line 3, but this does not resolve the communication breakdown. S7 switches to Japanese in line 4, asking *gravel te nani?* (trans: *what is gravel?*) S3 responds by elaborating that gravel is probably an item on S3's scavenger

Excerpt 15

1	S3	There is gravel
2	S7	gravel? ***<Clarification request>***
3	S3	Yeah.
4	S7	gravel te nani? <*Trans: "What is gravel?"*>
5	S3	Maybe it's on your list.
6	S7	Okay.
7	S3	Maybe this one is…
8	S7	Gravel, gravel… the animal, okay? ***<Clarification request>***
9	S3	Huh? No… the black…
10	S7	Block? The block? ***<Clarification request>***
11	S3	Here… this gray one. <*Observes S7 collecting a block of gravel*> Yeah, that's right. Maybe now you have gravel.
12	S7	Ah, okay. Gravel get.

hunt list. S7 continues to not understand the term, asking in line 8 if gravel is a type of animal. This confuses S3 in line 9, who starts to explain gravel by referring to the color of the material in Minecraft (grey with black specks). Confusion momentarily continues in line 10 when S7 mishears *black* as *block*. Finally in line 11, S3 is able to give some gravel to his partner, which S7 acknowledges in line 12. Despite multiple breakdowns in communication, S7 was eventually able to obtain gravel and make an authentic discovery of the material in Minecraft, where it is depicted as a grey and sand-like (and clearly not a type of animal).

The six examples presented in this section demonstrate that the design of the communicative tasks and their implementation in Minecraft successfully elicited robust and negotiation-rich interaction in the target language, as intended. In the next two sections, additional sources of interaction will be considered that reach beyond the virtual space itself. Section 5.6.4 will describe interaction related to the overall learning environment, including the computer hardware and non-virtual elements of the software, and Section 5.6.5 will describe interaction where both the virtual environment and the physical environment of the learning space became relevant.

5.6.4 Interaction Related to the Overall Learning Environment

This analysis has already discussed examples of meaningful interaction that were elicited not by the specific goals of the communicative tasks, but by related factors such as the need to maintain intersubjectivity between interlocuters and the need to understand the tasks themselves and the roles each partner would take in the interaction. This section will discuss examples of interaction where elements of the learning environment itself became foregrounded, including the software and computer hardware necessary to support the virtual environment.

In fact, one such example has already been discussed. Excerpt 6, in Section 5.6.1 contains an interaction in which the participants discuss where to find the item "jungle wood planks" in the Minecraft inventory of materials. In the Minecraft software, this inventory is implemented in a menu that is not itself part of the virtual environment, but which nevertheless became relevant in multiple interactions. As one of the participants (S12) is unsure about where to find the item in her inventory, her partner explains the location over multiple turns (lines 5 to 7). Note that the use of this particular building material follows the autonomous choices of the participants,

and for Student S12, the choice to find and use the material is in support of a cooperative endeavor to build a complex structure with her partner.

A second example, shown below in Excerpt 16, presents an example from Task Three, in which S5 has built a structure unobserved by his partner, S8, who is now trying to build a replica of the structure according to S5's directions. In line 1, S5 indicates to his partner that she should retrieve some items from the Minecraft inventory, including a ladder, which is an item that can be attached to an existing block in order to make a vertical surface climbable by an avatar. After the clarification request in line 2, which also contains a self-corrected pronunciation error, S5 explains where to find the item in line 3. Note that line 3 contains a self-corrected grammatical error, replacing the cardinal number *three* with its ordinal form *third*. Note also that this interaction is not specifically about a task goal, but about Minecraft's inventory menu system. Finally, in lines 4 and 5, the partners are able to confirm with each other that S8 was able to find the item.

Excerpt 16

1	S5	Now, we have ladder, and golden blocks, and rail, and skeleton skull. Okay?
2	S8	Sorry, where is latter? Ladder? ***<Clarification request>***
3	S5	Ladder? Ah, in… we have ladder in the decoration blocks. Rear in the three lines… third lines. ***<Repetition, elaboration>***
4	S8	Ah, okay, thank you.
5	S5	You got it? Now we have lines… big raw field, and we have line, okay?

Finally, Excerpt 17 shows a third example, from Task Two, in which the Minecraft software temporarily became slow to respond to input from the users and this fact became salient in the interaction. S13 begins the exchange by noting that the software is not responding normally, saying that his mouse doesn't work well. (It should be noted that when computer systems are not responding normally, it can be difficult to determine whether the problem lies with the hardware or the software.)

Excerpt 17

1	S13	I think my mouse doesn't work well.
2		Can we fly?
3	S9	I can't break the block.
4	S13	Okay.
5	S9	Okay.
6	S13	I can put on block in some places... I don't know why.
7	S9	Sorry? ***<Clarification request>***
8	S13	I want to put one block here, but if I click one… ***<Rephrase>***
9	S9	The same thing happened to me.

S9 is also experiencing the same issue and responds that she is unable to break any of the blocks in the virtual world (an action which requires input from the mouse). In line 6, S13 continues discussing the software issue, saying *I can put on block in some places… I don't know why*. In the context of software issue, the meaning of somewhat ungrammatical utterance is unclear: S13 could be attempting to say that he is *not* able to place blocks of material in the virtual environment, or he could be indicating that he is able to place blocks in some locations but not others. In any case, the utterance prompts a clarification request from S9 in line 7, to which S13 begins to respond by rephrasing his utterance and correcting the ungrammatical *put on block* to *put one block*. S9 then interjects, saying that the same thing has happened to her.

The examples discussed in this section demonstrate that elements of the overall learning environment, including the computer hardware and software itself, became foregrounded at certain points during communicative interaction, and that these elements also contributed to negotiations of meaning. As the next section will show, the influence of the overall learning environment beyond the virtual environment itself was not only limited to discussions of computer equipment, and also included instances of that spanned the physical and virtual environments.

5.6.5 Bridging the Virtual and Physical Environments

As mentioned, one of the notable aspects of the learning environment in this study is that learners shared both virtual and physical space. The exchange shown in Excerpt 18, from Task One, illustrates some of the ways in which the participants were able to take advantage of both of these environments while cooperating towards the goal of completing the provided tasks. During the exchange, S12 is tasked with observing the target shape and directing Student S9 to produce a replica. Both learners are working together in same walled-off portion of the virtual world and communicating via headsets and a dedicated voice channel. Physically, the learners are seated nearby each other, but not at adjacent seats.

The exchange begins with S9 proceeding to provide her partner with information necessary to replicate the target shape, which features blocks of colored wool arranged in a pattern resembling the letters K and U, as shown in Figure 10 in Section 6.2.1. There is a brief clarification request and repetition response in lines 2 and 3 over the term *K and U*. In describing the orientation of the design, S9 takes advantage of the 3D virtual space by making references to the location and orientation of her own avatar in lines 5 and 9. As this was the first task and the participants were still acclimating to use of Minecraft, the exchange then shifts to a discussion of how to place and collect material in the virtual environment. In lines 13 to 17, S9 quickly learns from her partner how to place a block in an exchange that includes a clarification request on the phrase *right button, on the mouse* which S12 responds to with repetition and some degree of elaboration. In Minecraft, placing material can be accomplished with a single mouse click. However, collecting material, mentioned in line 17, requires the user to punch or swing at a block multiple times until it finally "breaks" and the user can collect it. While this could be accomplished by repeated single mouse clicks, it is normally accomplished by clicking and holding the left mouse

Excerpt 18

1	S9	Yeah yeah, I saw the K and other letter… K and U.
2	S12	K and U? ***<Clarification request>***
3	S9	Yeah, K and U. ***<Repetition>***
4	S12	At the same time, um, K and U? From which direction? From the direction of the tower?
5	S9	Ah, okay. The direction I see now is the top. *<Referring to the direction the avatar is facing.>*
6	S12	Is the top? ***<Confirmation request>***
7	S9	Yeah. Top and bottom. ***<Elaboration>***
8	S12	Ah, okay. I see. So, face here, and so I'm…
9	S9	So, first we have to put the boxes to, uh, this line. The left… left side. *<Stands on left of tower and gestures towards the left side of the field. S12 watches S9's actions to understand meaning of "this line".>*
10	S12	Ah, okay.
11	S9	Must be all blue.
12	S12	All blue. Ah, okay. Okay, I see. ***<Repetition>***
13	S9	Well, I don't remember how to put the box. *<Referring to the method of placing blocks in Minecraft.>*
14	S12	Ah, right button, on the mouse.
15	S9	What? ***<Clarification request>***
16	S12	Right button, on the mouse. Put right button on the mouse… your mouse. ***<Repetition, rephrase>***
17	S9:	Uh… ah, yes, I got it. Okay. And how to collect, if I mistook to put the place?
18	S12	You continue to click the left button.
19	S9	Like this? *<Clicking repeatedly, which is heard and observed in physical space by S12>* ***<Clarification request>***
20	S12	Like… not always. Like you stay still. ***<Elaboration>***
21	S9	Ah! Okay.

button, which causes the avatar to punch or swing a tool repeatedly. S12 explains this in line 18, but does so ambiguously, saying *you continue to click the left button*, which seems to imply a repeated action. In line 19, S9 begins attempting to collect a block by clicking the mouse button repeatedly, and at the same time making a clarification request to verify that her understanding is correct. Crucially, based on S9's observable behavior in the virtual space, it would not be possible to determine whether she was holding the mouse button or clicking it repeatedly, since the resulting action of the

avatar is similar. Instead, S12, aware of her partner in the physical laboratory space despite not being seated adjacently, observes the repeated mouse clicks and immediately communicates to her partner in line 20 that the click should "stay still", which is sufficient for S9 to understand the correct method in line 21.

As this example shows, awareness of the participants' shared physical space also influenced the observed interaction and had an impact on the resulting actions participants took in the virtual space. As will be discussed in Chapter 7 on participant feedback, participants made use of the physical space in service of completing the tasks in other ways as well, although this is not always evident in the audio transcriptions.

5.7 Conclusions on Learner Interaction

Recall that the goal of task-oriented communicative language teaching is to elicit learner interaction in the target language that thought to be beneficial in language learning, such as interaction that features negotiation of meaning. The first of the three research questions defined for the main study asked about the types of interaction that could be elicited during task-orientated interaction in Minecraft. As the examples and analysis in this chapter have demonstrated, a substantial volume and a wide variety of interaction was observed. It first must be noted that the vast majority of interaction occurred in the target language, and featured a very high degree of learner autonomy, with minimal intervention from the researcher. All tasks succeeded in eliciting negotiation of meaning between the participants as they worked towards the goals outlined for each task. A greater volume of negotiation of meaning was found with tasks featuring an information gap than for the task featuring a decision-making task, as predicted by Prabhu (1987) and TBLT theory. Along the way, incidental interaction featuring negotiation of meaning was also found related to general intersubjectivity between the participant pairs; direct discussions related to

the participants coming to understand the tasks and their individual roles in solving them; the learning space *outside* the virtual environment, including the computer hardware and software; and interaction that bridged both the virtual and physical environments. This evidence helps to support the findings first reported in the pilot study with additional evidence and constitutes a positive finding for the first research question of the main study.

The second and third research questions of the main study will need to be addressed with evidence from participant feedback, which will be discussed in detail in the next chapter.

6 Main Study: Participant Attitudes and Feedback

The practice of language education is complicated by the views, attitudes, and opinions of learners. Learning frameworks, technologies, and theoretical approaches that do not inspire a willingness to participate on the part of the learners are very unlikely to be successful in the long term, since without willing participation, learners are not likely to see substantial gains in competence with the target language (McCroskey & Baer, 1985). Consequently, evaluation of participant attitudes is a key consideration for empirical studies in SLA. The previous chapter introduced the main empirical study presented in this thesis and provided a detailed analysis of the learner interaction evident in transcripts of the data collection sessions. In this chapter, the attitudes and feedback from the study participants will be assessed through an analysis of post-study questionnaires and semi-structured interviews. Section 6.1 will present an analysis of the Likert item responses in the post-study survey. Section 6.2 will present participant feedback from written responses to survey questions and comments made in post-study interviews. Section 6.3 will offer brief concluding remarks.

6.1 Post-Study Likert Item Responses

Similar to the pilot study, after the completion of the data collection sessions for the main study, the participants were asked to complete a questionnaire (shown in Appendix F) that included 13 Likert items. The participants were asked to express their agreement or disagreement with each Likert item by selecting one of these five labels: strongly agree, agree, no opinion, disagree, and strongly disagree. Each label is then associated with a numerical value (five through one, respectively), allowing a mean score to be calculated, where values greater than three indicate agreement and values less than three indicate disagreement. Table 11 shows mean Likert score for

Table 11: Summary of mean scores for Likert item responses for main study

Id.	Question	Mean
Q1	*The game was easy to use.*	3.87
Q2	*The tasks and directions were easy to understand.*	3.80
Q3	*Solving the tasks was easy.*	3.13
Q4	*Traditional classes are more useful than playing this game.*	2.80
Q5	*I could learn new words and expressions by playing this game.*	3.13
Q6	*Playing this game cannot help me improve my English ability.*	2.13
Q7	*Most of the discussion was not very useful.*	2.27
Q8	*I could speak and use English successfully during the game.*	3.27
Q9	*There was not much feedback from the other player.*	2.93
Q10	*In the game, I could speak English more freely than in a regular class.*	3.67
Q11	*Using the game was more interesting than a regular class.*	4.20
Q12	*I enjoyed using the game.*	4.20
Q13	*I would like to play this game again in the future.*	3.67

Likert scale: (5) strongly agree, (4) agree, (3) no opinion, (2) disagree, and (1) strongly disagree

each item in the questionnaire, and Table 12 shows the summary of individual responses. Note that in the items, Minecraft is referred to as a "game" rather than as a virtual world. As the participants were not expected to possess any technical expertise on the differences between games and virtual worlds, the more familiar

Table 12: Summary of individual post-study Likert item responses for main study

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
S1	5	4	4	4	2	3	2	4	3	4	4	4	4
S2	4	4	3	3	2	2	3	4	3	3	4	4	4
S3	3	3	4	2	3	2	2	3	4	4	4	4	3
S4	4	4	2	2	4	2	2	3	2	4	5	5	5
S5	4	4	3	2	5	2	3	4	3	5	5	5	5
S6	4	3	3	4	2	1	3	3	4	3	3	2	2
S7	2	2	2	2	3	2	2	4	2	4	4	4	4
S8	4	5	4	2	4	3	3	4	2	3	5	5	4
S9	4	4	2	2	4	2	2	3	2	3	4	4	4
S10	3	4	2	3	2	2	2	2	3	2	4	4	3
S11	4	4	5	2	1	3	2	4	4	5	4	4	4
S12	4	4	2	4	5	1	1	1	2	4	3	4	2
S13	4	5	4	3	2	2	1	1	4	4	5	5	4
S14	4	4	2	3	4	3	2	4	2	3	4	4	4
S15	5	3	5	4	4	2	4	5	4	4	5	5	3

Likert scale: (5) strongly agree, (4) agree, (3) no opinion, (2) disagree, and (1) strongly disagree

terminology was selected for the questionnaire. Note also that each item is labeled with a short identification code (Q1, Q2...) for reference, and the study participants are referred to using identification codes from Table 8 (S1, S2...). Finally, it must be noted that this analysis is of course subject to the well-known issues with participant feedback reliability (Bachman, 2004; Dörnyei, 2007) that are relevant to much qualitative work in SLA, and therefore the following results should be viewed as informative rather than definitive.

6.1.1 General Impressions of Minecraft

One of the goals of the questionnaire was to gauge the participants' general impressions of Minecraft and the experience of using it as an arena for cooperative communication tasks. Items Q1, Q12, and Q13 were designed to address this issue. The mean score of Q1 (*The game was easy to use*) was 3.87, indicating that the participants felt competent using Minecraft despite having little to no prior experience with the platform. Item Q12 (*I enjoyed using this game*) has a mean score of 4.20 and the mean score for Q13 (*I would like to play this game again in the future*) was 3.67, indicating a favorable impression of the software and overall experience of using it in a cooperative learning environment.

6.1.2 Impressions of the Tasks

The participants' impressions of the design and implementation of the learning tasks was also a key consideration, which was addressed by items Q2 (*The tasks and directions were easy to understand*) and Q3 (*Solving the tasks was easy*). Q2 had an average mean score of 3.80, indicating that the participants were confident in their ability to understand the task goals for each session. As previously discussed, the process of participants coming to an initial understanding task goals themselves was also subject to negotiation of meaning. The positive result of a 3.80 mean score for this

item thus indicates that the participants largely judged those negotiations to be successful.

The mean score for item Q3 was lower, at 3.13. The tasks were designed to be easy enough for the participants to complete successfully, but also challenging enough that they would require meaningful and attentive communication between partners. The score of 3.13 for Q3, combined with the observation that the participants were in fact successful in completing the tasks during the data collection sessions, indicates that the task difficulty was set appropriately.

6.1.3 Impressions of Communicative Tasks in Minecraft for Language Education

Regardless of the participants' attitude toward the virtual world and the tasks as enjoyable and worthwhile activities, it is also important to assess their attitudes towards the potential use of these techniques as part of formal language education programs. Item Q10 (*In the game, I could speak English more freely than in a regular class*) received a mean score of 3.67, Q11 (*Using the game was more interesting that a regular class*) received a mean score of 4.20, and Q5 (*I could learn new words and expressions playing this game*) received a mean score of 3.13, indicating that the participants would likely be open to some degree of incorporation of virtual worlds in language learning programs. The response for Q5 was only slightly above neutral, possibly indicating that a greater level of vocabulary support could be incorporated into the task descriptions, which in the study were provided with relatively minimal support. However, item Q4 (*Traditional classes are more useful than playing this game*) had a mean score of 2.80 and Q6 (*Playing this game cannot help me improve my English ability*) had a mean score of 2.13, indicating that the participants tended to disagree with these statements and did in fact believe that the activities of the study could provide benefits for language learning.

6.1.4 *Impressions of Communication Strategies and Self-Efficacy*

Finally, it is important to assess the participants' own views of the success of their communication strategies during the study, as it has been claimed in SLA literature that feelings of self-efficacy are closely related to motivation and that greater self-efficacy may predict greater learning success (Graham, 2022; Leeming, 2017). Item Q8 (*I could speak and use English successfully during the game*) addressed this directly, resulting in a mean score of 3.27. Although this score shows more agreement than disagreement, it is close to the neutral score of 3.0 and may be reflective of the number of communication breakdowns that occurred during the sessions. Although the participants were able to resolve these issues through negotiation of meaning (as shown in the previous chapter), the frequent need for this negotiation may have led some participants to believe that the communication was not particularly "successful." Contrastingly, item Q7 (*Most of the discussion was not very useful*) received a mean score of 2.27, indicating disagreement and suggesting that the participants did find that the interaction during the sessions was valuable. Finally, Q9 (*There was not much feedback from the other player*) received a nearly neutral score of 2.93, showing that the participants likely felt that their partners could have been more effective at communicating during the sessions. Again, since the participant groups during the sessions were able to complete the tasks, the communicative interactions were ultimately successful. The neutral score thus may indicate a feeling on the part of the participants that communicating successfully to achieve the task goals was harder than they expected it to be.

6.2 Written Survey Responses and Post-study Interviews

In addition to the Likert items, each of the 15 participants also completed written responses to eight items on the post-study questionnaire, followed by semi-structured

interviews that were conducted with each group of participants after the final data collection sessions. This section will highlight four themes that emerged in this feedback: Comments by the participants on their attitudes towards the activities of the study and effects on their willingness to communicate; comments about communication strategies and dealing with breakdowns in communication; comments regarding the intersection of physical and virtual space; and finally, participants' comments on potential areas of improvement for future work. As this written feedback was produced by the participants through a more productive and concerted process than the Likert responses, it may represent a more reliable source of qualitative data.

6.2.1 Attitudes and Willingness to Communicate

As mentioned in Chapter 2, part of the rationale for the use of digital games and virtual worlds in language learning is the existence of evidence that these environments promote a willingness among learners to engage in second language communication. Consistent with previous work and researcher observation during the data collection sessions, feedback from the participants indicated both positive attitudes and a positive effect on willingness to communicate. The following comment from participant S6 was typical:

> Playing this game, we could be relaxed about speaking English and class itself. Every time I speak other language than Japanese, I get nervous. However, in this class I felt less pressure than usual. And when we cleared the tasks, we felt sense of accomplishment and thought that it is enjoyable to use English. (S6)

S6 describes typical feelings of pressure and nervousness associated with foreign language communication that may reduce willingness to communicate and states that this was alleviated by the low stress environment of the study. This finding suggests the environment may have encouraged risk-taking and a more beneficial communicative experience overall. A similar comment was made by S9:

> I think that the activities were effective to improve English communication skills. I liked the atmosphere during the activities and feel freer to express my opinions in English. Furthermore, pair works and group works increased the opportunities to use English. (S9)

Note that in addition to expressing positive attitudes about the relaxed atmosphere of the sessions, both comments also indicated having a positive attitude towards the collaborative nature of the interaction, providing validation for the design and implementation of the tasks. Although the tasks, by design, were sometimes challenging, participant feedback indicated that attitudes remained positive, as expressed by S10:

> I think this kind of communication in this course is effective for students developing English speaking ability… Having chances to speak in English as much as possible is important. I found it a little difficult to explain the shape in English, but it was a good experience for me. We students could feel motivated because Minecraft is an enjoyable game. I think using the computer game to learn English is very useful for young children too. (S10)

It should further be noted that S10's comment and the comment by S9 both report a belief in the effectiveness of the activities for developing communicative skills in the target language, in addition to finding them enjoyable. Finally, the following comment by S12 summarizes a typical view of the value of overcoming the communication challenges posed by the tasks:

> The biggest gift I received from the activities is the awareness of lack of my English skill. But since it was pair activities, the partner encouraged me to continue to use my poor English. And also, since it was fun activities, I didn't abandon to face difficulties of communicating. So I think it is effective system. (S12)

In summary, the participants' feedback revealed positive attitudes toward the tasks and Minecraft itself, with indications that the participants felt the overall

environment was low-risk and lowered barriers to communication through participation in collaborative and enjoyable activities.

6.2.2 COMMUNICATION STRATEGIES

The discourse analysis shown in the previous chapter revealed a wide range of scenarios that produced negotiation of meaning between participant pairs, and it is clear from that analysis that the participants were faced with communication challenges by the tasks and were able to effectively use negotiation strategies to resolve those difficulties. Analysis of the feedback revealed that the participants were aware of this and were able to provide accurate descriptions of their own communication strategies. This realization may help to foster positive attitudes toward the communicative tasks and their potential value in promoting language acquisition. The following comment by participant S2 is representative:

> When I faced [communication troubles], I tried to use different words of similar meaning. If even that was not helpful, my partner asked some questions. Those questions became like hints for me because they contained words that I wanted. I asked questions the same as my partner when she or he had troubles. (S2)

Here, S2 describes three effective strategies: responding to a breakdown in communication by rephasing an utterance, asking for clarification (both of which are strategies for meaning negotiation that were frequently seen in the transcripts), and scaffolding. In the following comment by S6, a successful rephrasing approach is described:

> During the session I had some difficulty with my partner when I told her how to build the building I made. This is because I could not tell her effectively how to put the block and I could not know how to say the situation in front of me in English because of lacking some specific vocabulary. So, I tried to change the way I explained so that I could explain with my vocabulary. By doing this, I could somehow tell my partner the situation. (S6)

In the final example, S9 describes herself and her partners using clarification requests and subsequent discussion (negotiation) to resolve breakdowns in communication and additionally expresses a belief (shared by the field of interactionist SLA) that these breakdowns in communication presented opportunities for learning.

> When I didn't know the meanings of the words and expressions, I asked my partner. The trouble gave use opportunities to talk each other in English. My partner also asked questions if she did not understand my explanation. Thus, how to solve the troubles was just to talk and to discuss each other. Many of the troubles because of my limited English vocabulary were resolved in the end. (S9)

Overall, the feedback on communication strategies was consistent with the transcript analysis presented in Chapter 5. The participants reported experiencing breakdowns in communication during the sessions that were then resolved largely through negotiation of meaning and the use of scaffolding. This feedback provides additional evidence that the communicative tasks implemented for the main study functioned effectively in the Minecraft environment.

6.2.3 Using Both the Physical and Virtual Space

Feedback analysis also provided additional evidence that the participants made use of the physical space in the laboratory where the main study sessions occurred to augment the computer-mediated interaction in the virtual space. Recall that during the data collection sessions, the participants were seated at an L-shaped row of laptop computers and paired with non-adjacent partners. Paired participants could communicate via voice using headsets and each pair was assigned a dedicated communications channel. However, since the available space was limited, the participants could quickly discern who in the room they were paired with, as described by participant S8:

> It was hard to tell my partners how to construct the picture because they probably don't use the words "row" and "column" often. What I called "blocks" they called "boxes", so I had to listen to what they were saying so that we could

> understand what we were saying to each other, and to get our tasks completed. I suppose because we were all in the same room, we could have some form of face-to-face conversation once we worked out who we were partnered with (S8)

As S8's comment seems to indicate, the use of face-to-face communication may have been preferred by some participants when difficult breakdowns in communication arose. Similar comments were expressed by S4 and S11:

> My partner and I sometimes forgot to push button when talking. It's maybe because her voice can be heard directly without using headphones. (S4)

> I stopped using the headphone and talked with her face to face. I happened to see her playing screen at that time (S11)

The comment by S11 additionally noted that during face-to-face communication, he was able to view his partner's computer screen, which likely provided a visual clue to solving one of the tasks more easily. Although such interaction was not planned, occasional visual confirmations of this sort during the interaction do not seem to have prevented the occurrence of negotiation of meaning during the sessions, as evidenced in the previous chapter. In similar comments, participant S6 reported looking at the monitor of a neighbor who was working on the same task in order to discover hints for guessing the meaning of the terms "tilt" and "slant":

> We had some communicative difficulties in doing the tasks. Particularly, we did not know the word "tilt" or "slant" ("naname" in Japanese), so when we should set blocks obliquely, we had big difficulty. In such cases, sometimes I cheated. I could not know what to do, so I glanced the monitor of my neighbor's and somehow cleared the task. I think my partner did so, too (S6)

In addition to using the physical space for face-to-face communication and visual clues, the close proximity of multiple pairs of learners working on the same tasks also lead to instances of scaffolding from neighboring groups, as reported by S13:

> Although the words I wanted to say didn't come out as promptly as before, I could hear people around me talking out of my headphone. So I used a part of their words and expressions to explain the shapes (S13)

As previously discussed, task-based learning approaches set in virtual worlds have not yet seen widespread classroom use at any level of formal education (potential reasons for this will be examined in the next chapter). The evidence here of such interaction (including linguistic interaction) in shared physical space to support collaborative tasks in a virtual space is significant because it provides insight into to how these learning approaches may perform in classroom environments and other scenarios in which physical and virtual space are both present.

6.2.4 Areas of Improvement

Finally, analysis of learning feedback identified several components of the study and overall approach that may be evaluated for potential improvement in future work. One of these significant areas was technical difficulty, with participants mentioning an issue with lag (slow responsiveness of the software) in the first Minecraft session. Although the exact cause was never determined, it seemed to be related to the use of a 32-bit version of the Java Runtime Environment with the most recent (at the time) version of Minecraft on the client computers, which were running a 64-bit version of the Windows operating system. Updating all the client computers to the most recent 64-bit version of Java solved the issue and no further lag occurred during the duration of the study. Although the issue was quickly resolved, it served to highlight the need for technical troubleshooting that is characteristic of many CALL approaches.

A similar technical issue that was also mentioned in participant feedback was an issue with the TeamSpeak3 voice communication server software and headsets (headphones with attached microphones). The software has a voice activation feature which is intended to transmit audio from the microphone only when the software

detects that the user is speaking, thus helping to eliminate unnecessary and distracting background noise. This did not work well in the laboratory environment, where participants were seated close together, as the audio signals often became activated when a nearby person was speaking, rather than the person wearing the headset. This resulted in the dedicated audio channels for each pair of participants becoming cluttered during the first sessions. The issue was resolved by turning off the voice activation feature and instead having each participant push and hold a key on the keyboard to activate the microphone. Although this made the act of speaking somewhat more of a deliberate action for the participants, it successfully resolved the issue of excessive background noise in the audio channels.

In addition to these issues, another potential area of improvement that was cited by several participants involved explicit instruction of useful vocabulary prior to the tasks. The participants indicated that the tasks would have been easier and been solvable more quickly if the task descriptions had included lists of recommended vocabulary, such as with this comment from S15:

> I think all tasks were good because they varied slightly in difficulty and in their respective procedures. Handouts of examples of words that could be used could have improved the tasks, such as "besides", "on top", "layer", "cube", "square", "frame", and other basic words that some had trouble with. (S15)

It is very likely that such handouts would have made the tasks easier. However, in order to promote opportunities for negotiation of meaning, the task descriptions and accompanying explanations from the researcher were designed to provide only as much information as was necessary to define the guidelines and goals for each task. Although such vocabulary lists may be useful in contexts where specific vocabulary items are being targeted by the educator, the goals of this study did not involve targeting specific vocabulary, and such support was judged to be unnecessary in this case.

6.3 Conclusions on Learner Attitudes

The second research question for the main study addressed the attitudes of learners towards communicative tasks in Minecraft. The analysis of participant feedback in this chapter indicates that the attitudes were positive overall, and that the learners who participated in the study found the tasks and the virtual environment to be enjoyable to use and recognized that the interaction elicited by the tasks was beneficial for language learning.

The third research question for the main study addressed the impact of a mixed physical and virtual environmental space on the participants' communication strategies during the completion of the tasks. As indicated in Section 5.6.5 and in this chapter, data suggests that the participants preferred face-to-face communication during instances of severe breakdowns in communication, and that additional information sources in the physical environment (such as neighboring participants' computer screens or overheard conversation) were leveraged for scaffolding vocabulary and for helping to clarify meaning in some cases.

Overall, these are positive (though not definitive) results, and indicate the potential for the use of Minecraft and other easily modifiable virtual environments as arenas for task-based interaction in language education programs. Learners, however, are not the only stakeholders in education, and the success of approaches such as the one suggested here depend not only on the attitudes of learners and potential benefits, but also on the actual perceptions of educators and, in the case of higher education, university administrations. To understand some of the challenges that may limit the acceptance of virtual worlds in higher education and how those challenges may be addressed, the next chapter will report on a survey of university second-language educators in Japan regarding their attitudes towards these approaches.

7 EDUCATOR ATTITUDES

Even a casual familiarity with university-level language education courses is sufficient to conclude that the prevalence of digital games and virtual worlds remains extremely limited, despite positive results reported in the academic literature. The use of digital games and virtual worlds in formal language learning contexts, like any other innovation that is implemented in software, requires the effective integration of computer technology. As mentioned in Chapter 2, in the Japanese context, one of the most notable investigation on the adoption of computer technology in higher education comes from Jane Bachnik's edited volume *Roadblocks on the Information Highway: The IT Revolution in Japanese Education* (Bachnik, 2003), which documented a widespread belief in the value of information technology among stakeholders in education and uncovered many of the institutional, cultural, and practical obstacles facing its increased adoption. However, in the years since *Roadblocks* was published, there have been developments that may have affected the integration of information technology in Japanese higher education. We might therefore wonder what, if anything, has changed over the years, whether the barriers identified by Bachnik are still in place, and whether these have been a factor in limiting the adoption of digital games and virtual worlds in classrooms. This may provide insight on whether positive results such as those reported in previous chapters of this thesis may have an impact on the actual practice of SLA in educational contexts. Note that a version of this chapter was previously published as Swier and Peterson (2018).

The use of 3D digital games and virtual worlds in educational contexts requires both significant availability of computing resources and freedom for instructors to leverage those resources for innovative pedagogical methods. To what degree is the limited use of these environments simply a consequence of longstanding obstacles to the use of technology in general? Here, three principle obstacles to the

Table 13: Obstacles to the adoption of technology identified by Bachnik (2003)

Obstacle	Cause	Effect
Lack of technical support	Tendency to hire generalists rather than specialists for staff positions; reliance on informal "volunteer" faculty/staff for support	Faculty who wish to use computer technology receive little technical support; must often manage technical issues themselves
Institutional barriers to effective use of technology, including the internet	Bureaucratic approval process that requires ample precedent for new initiatives; prioritization of regulation and control over supporting innovative methods of teaching and learning	Computer equipment and access to the internet, even when available, become far less usable
Focus on technology itself, rather than on how to adapt pedagogical methods to incorporate technology effectively	Pedagogical methods that most effectively integrate technology are ignored because their student-centered nature is a direct challenge to the traditional top-down, teacher-centered organization of university education	Computer technology may be promoted and installed at universities, but effective integration of that technology into learning programs is rarely achieved or even contemplated

adoption of technology in Japanese higher education are reviewed, as identified by Bachnik (2003). A summary is shown in Table 13.

In Bachnik's view, the obstacles arise from an impasse that has developed in Japan between administrators (in both government and at educational institutions) who enthusiastically promote the use of information technology as a matter of policy, and an entrenched bureaucratic structure that is highly resistant to any reforms that might affect the status quo. For Bachnik, the effective use of technology requires an educational system that is highly flexible, interactive, and centered around the students rather than the teachers. She writes that the pedagogies that have emerged to make effective use of technology almost always involve approaches "which promote creativity, individuality, innovation, and leadership qualities" (2003, p. 9). But despite efforts by administrators to promote the use of technology, the implementations seen in Japan at the time of her writing are described as suffering from both a prior

resistance to reform from the bureaucracy itself and a lack of consideration of just how extensive the reforms would need to be in order to realize the expected benefits.

Although Bachnik's observations are now approaching 20 years old, the type of technology considered is similar to what is still most often used for 3D games and virtual worlds. It is therefore reasonable to suggest that obstacles to the implementation of technology itself have been a contributing factor to the low adoption rate of these platforms. In order to explore the degree to which these obstacles may continue to be factors, as well as other reasons for the low adoption rate, the next section discusses findings from a survey and series of interviews with language teachers on their related attitudes, interests, motivations, and working conditions.

7.1 Survey Methodology

This research adopted a primarily qualitative approach to data collection, with the largest data source consisting of semi-structured interviews with current language teachers. These interviews form the primary basis for the findings. As a way of identifying suitable candidates and of gaining insight to guide interview sessions, a survey of university language teachers in Japan was conducted to explore the following four key issues: teachers' views on the availability of computer equipment at the institutions where they teach, views on whether universities were generally supportive of innovative teaching methods, views on the state of academic research regarding 3D digital games and virtual worlds, and views on the benefits of using these platforms given the effort required to bring them into the classroom.

Several methods for distribution of the survey were considered. One option included distributing an online survey by email to faculty members listed as language instructors on university websites, a methodology that was used by Franciosi (2016).

However, this method has the unfortunate property of excluding adjunct faculty members, who teach a large portion of language classes at many universities, but who are employed on part-time contracts and typically not profiled on university websites. In order to reach this population of teachers, a method of snowball sampling was adopted in which an initial group of 20 participants from the researchers' professional networks were asked to complete an optionally anonymous online version of the survey and forward the survey to friends and colleagues who were likely to fit the survey criteria. The initial participants consisted of both full-time and part-time teachers from twelve universities in the Kansai, Kanto, Chugoku, and Shikoku regions of Japan. The survey was also shared to several online communities that were deemed likely to have a large percentage of members fitting the survey criteria. Although non-probabilistic sampling methods limit the applicability of the data to making quantitative conclusions about a population, this method was sufficient for the current analysis.

Each respondent was asked to complete 12 multiple choice background questions, 24 items based on a five-point Likert scale, and two open-ended questions. Based on whether the respondents indicated having experience using 3D games or virtual worlds with their students, respondents were directed to slightly different sets of questions to ensure that only those who had actually used the techniques before would be asked about their past experiences with the technology. The open-ended questions asked respondents to write about the reasons why they had or had not chosen to use digital games and virtual worlds in the classroom, and about the challenges they had faced or would expect to face in order to use these technologies. In a possible indication of how marginalized 3D games, virtual worlds, and other CALL approaches continue to be, a relatively low number of 42 respondents completed the survey, with eight of these respondents having previous experience using 3D

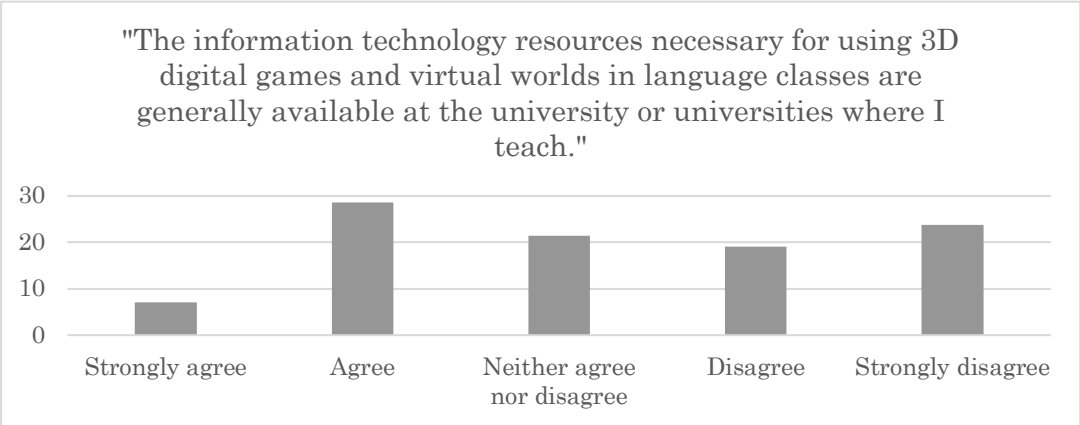
digital games or virtual worlds in language learning settings. From these 42 respondents, 12 were selected for in-depth one-on-one interviews ranging from 30 to 60 minutes, conducted in-person or via video conference. The selection of interviewees was based primarily on whether the respondents indicated a willingness to be interviewed and on the depth and informativeness of their responses to the open-ended questions. Five of the interviewees had significant experience with implementing CALL methodologies and/or non-digital games in the classroom. Of these five, three had used 3D games or virtual worlds, including *Second Life*, *Minecraft*, and the digital adventure games *Life is Strange* and *The Walking Dead*. The remaining seven interviewees had no experience with these methodologies.

In the remainder of this section, I will discuss the findings as they relate to the four key issues identified above, highlighting survey results to motivate discussion and reporting on interviews with current language teachers.

7.1.1 Are the Necessary Technology Resources Available?

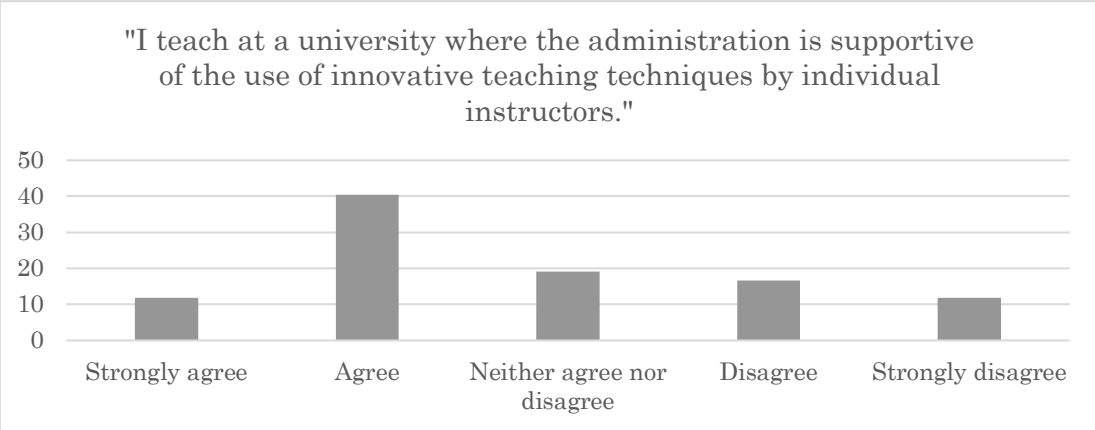
As shown in Figure 14, responses to a Likert item asking about the availability of the technology resources necessary to implement 3D games and virtual worlds showed a somewhat polarized range of opinion among the survey participants, with responses overall being slightly skewed toward the view that such resources are not in fact generally available. These responses include a range of experiences. Many respondents, of course, have never used or tried to use these methodologies, and 83% of respondents indicated that they did not know anyone who used 3D games or virtual worlds for teaching, so for these respondents, their view of computer resource availability may contain a degree of speculation. However, in response to open-ended questions about the reasons for not trying these technologies and about anticipated issues with their implementations, respondents who had not tried these innovations before cited equipment availability as a major concern, particularly in regard to

Figure 14: Percentage of responses to indicated Likert item on availability of computer technology



scheduling access to computer labs. In interviews, there was clear agreement that the availability and usability of computer resources at universities is a significant hurdle. Although many universities have computer labs with powerful machines and network infrastructure that has the capability of running the software for 3D games and virtual worlds, none of the interviewees expressed confidence in their ability to persuade their institutions to acquire the necessary software or to install it on centrally administered computers. In the words of one interviewee: "My university would simply say 'no'". Another interviewee, a tenured faculty member at a large private university in the Kansai area, relayed his experience of making a request to the IT administrators at his institution to install *Windows Movie Maker*, a free application which at the time was the main offering from Microsoft for adding basic video editing capabilities to Windows. The IT administrators declined, citing unspecified security vulnerabilities. The faculty member who made the request reported suspecting that a desire to limit workload and avoid any unnecessary complications were more influential factors in the decision, echoing the obstacles described by Bachnik. The faculty member did not pursue the matter, and the software was never installed. Finally, the interviewees who did have experience using these methodologies were all full-time university faculty members who used

Figure 15: Percentage of responses to indicated Likert item on administrative support for innovation

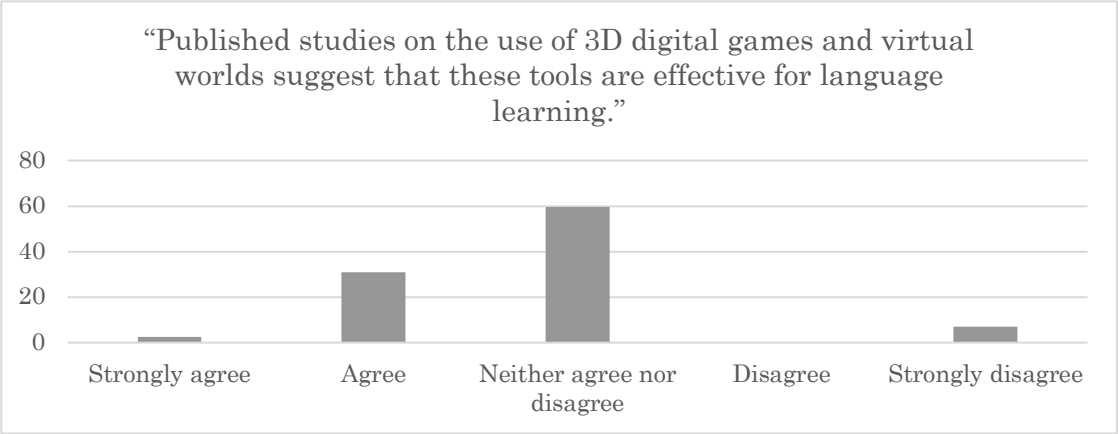


collections of computers over which they had administrative control, an arrangement that is impractical for most full-time university faculty members, and almost certainly impossible for adjunct faculty members.

7.1.2 Are Universities Generally Supportive of Innovative Teaching Methods?

The responses to the item shown in Figure 15 indicate that overall the respondents tended to feel that the universities where they worked were supportive of innovative teaching techniques. This feeling of supportiveness is significant because it may play a role in the decisions that individuals make on whether to pursue new teaching methods. However, in an open response question asking about the reasons for not having tried these technologies, fear of administrative disapproval emerged as a theme. As one part-time teacher wrote, "The folks at the top say we can customize lessons, but in reality, if you do, there is a kind of unconscious resistance and backlash." Additionally, participants who had experience implementing games (including non-digital games) or virtual worlds in the classroom indicated that they often did so quietly and largely without the knowledge of their colleagues. One key reason cited for this secrecy was a general feeling that their colleagues would not see these techniques as having educational value. "They think of games as just playing,"

Figure 16: Percentage of responses to indicated Likert item on results of studies appearing in academic literature



is how one interviewee described the viewpoints of his colleagues. A second reason is that use of these techniques may sometimes be seen as inconsistent with the syllabi of the courses in question. Although interviewees reported using these techniques with language courses that included the development of communicative competence as a goal, the prevailing viewpoint was that, perhaps due to a continuing stigmatization of both CALL and games, these innovations were so recognizably different from traditional approaches that they may be seen by colleagues or students themselves as being unacceptable, inappropriate, or lacking in academic value.

7.1.3 Does Academic Research Make a Difference?

The respondents were largely noncommittal about what has been claimed regarding these methodologies in published academic studies, as shown in Figure 16. In interviews, the participants who had not used 3D digital games or virtual worlds before in their classes generally indicated that they had very little knowledge or interest in the related academic literature, while those who did have experience with these methodologies appeared to have greater familiarity with the literature, and in some cases, had conducted research on the subject themselves. There was broad agreement however, that while academic research was valuable, the results of academic studies were unlikely to be particularly persuasive to the majority of

teachers. As one interviewee put it in a typical comment, "I don't think the research makes much difference. I don't think most teachers worry about that very much." A further consideration is that as the range of language education research has expanded, many positive results have emerged in many different subfields, including subjects that may be more familiar to typical teachers and less burdened by technological issues and other barriers associated with CALL applications. One survey respondent who had not used digital 3D platforms before stated, "I do not have a lot of intrinsic desire to delve into virtual worlds. To be honest, I think that VR could be a very powerful learning tool. That said, there are many paths toward student learning and I am choosing one that is more familiar to me." The importance of having a prior interest in these types of innovations was also reflected in the interview comments of teachers who had used these technologies before, with curiosity, prior experience as a learner, and a desire to experiment with the technology being cited as key factors that motivated teachers to use of these innovations with students.

7.1.4 Is the Adoption of 3D Games and Virtual Worlds Worth the Effort?

As shown in Table 14, survey respondents who reported having no experience using 3D games or virtual worlds generally agreed that the benefits of incorporating these methodologies into even one of their classes was unjustifiable given the potential benefits, and the few respondents who did have experience implementing these methodologies did not report being more satisfied than unsatisfied overall with the results of their efforts. In interviews, teachers who had experience using 3D virtual platforms in classroom situations reported that implementation of these methodologies required significant effort. One full-time teacher reported that preparation to use a digital game one time in only one class turned into a nearly semester-long project to conduct tests of the software with volunteer students on

Table 14: Perceptions of costs and benefits of 3D digital platforms

	Respondents who had not used 3D platforms: *"The effort required to incorporate a 3D digital game and/or virtual world into one or more of my current classes is unjustifiable given the potential benefits for me."*	**Respondents who had experience using 3D platforms:** *"I am satisfied with the results of my efforts to incorporate a 3D digital game and/or virtual world into a language education class."*
Strongly agree	9 (28.1%)	1 (12.5%)
Agree	11 (34.4 %)	2 (25%)
Neither agree nor disagree	8 (25%)	2 (25%)
Disagree	4 (12.5%)	2 (25%)
Strongly disagree	0 (0%)	1 (12.5%)

computers in his office, troubleshoot technical issues, and prepare the necessary instructional material. Although the teacher felt that use of the game was both successful and productive for his students, he also found that the tradeoff was difficult to justify, commenting "maybe it wasn't the best use of time." For many teachers, especially those who teach part-time, the time, space, and research funds required for such preparations may be simply unavailable. A respondent who was a part-time teacher working at several universities described his situation as follows: "As a person trying to make a living by running between several different locations a day, sometimes in different cities, suddenly being put into a new class with a new plan, I have to weigh the effort/result ratio. In short, there is little incentive (or in fact there is disincentive) and time to ask for or try something new."

7.2 Conclusions on Educator Attitudes

The findings of this chapter suggest that Japanese universities provide a challenging environment on many fronts for the use of 3D digital games and virtual worlds in language learning contexts. Among other issues, the teachers who shared their views

on the survey and in interviews described needing to provide their own technical support, having difficulty installing software or scheduling time to use computer labs, and feeling a sense of resistance from administrators and colleagues regarding the use of these teaching methodologies even in cases when the necessary computer equipment itself was available, suggesting that the principle obstacles identified by Bachnik (2003) continue to be factors. And in such an environment, which is already challenging for many techniques that use CALL methodologies, 3D games and virtual worlds may be faced with even greater challenges due to an ongoing stigma against games, as teachers who had tried these techniques (including, in some cases, with non-digital games) often described doing so quietly in the hope of avoiding the attention of colleagues and administrators. These findings also suggested that working conditions, particularly of adjunct faculty members, may present challenges to the adoption of these technologies, as the teachers who were able to successfully use these techniques tended to be full-time employees who had access to office space and research funds that facilitated the necessary preparations. Finally, the findings suggest that the teachers who had experience using 3D games or virtual worlds in their classes tended to be those who had a strong prior interest in the technology, which may have provided motivation to overcome any difficulties encountered.

Having provided robust evidence in the previous chapters that Minecraft provides an effective and highly usable virtual platform for TBLT approaches and having provided evidence in this chapter that despite positive results such as these, hurdles remain to the incorporation of technology in higher education, the final chapter will summarize the conclusions of this work and offer suggestions for future directions.

8 CONCLUSIONS

In this closing chapter, I will summarize the presented research and note the key findings (Section 8.1) before discussing the study's limitations (Section 8.2) and offering considerations for future research (Section 8.3).

8.1 SUMMARY AND KEY FINDINGS

This study has been about addressing important and persistent challenges that have faced the use of virtual worlds as arenas for language learner interaction. The work began by noting the strong theoretical foundations that support the use of virtual worlds in SLA. Within the interactionist framework that characterizes modern SLA theory, compelling rationales for virtual worlds are supported by both the cognitive and sociocultural perspectives of language learning. As might be expected, these justifications have led to a substantial and growing body of research that empirically evaluates the use of these environments with language learners. However, as was demonstrated in Chapter 2, past research has strongly favored the platform Second Life, a virtual world that has many demonstrated positive aspects, but which is also characterized by usability issues that have limited the range of tasks studied in the environment. In particular, the review of previous virtual world studies in Chapter 2 noted that communicative tasks studied in Second Life have tended to involve open-ended communication on particular topics, a class of tasks that are expected in task-based language teaching theory to elicit less negotiation of meaning between interlocuters than tasks involving gaps in information or reasoning. At the same time, it was observed that actual classroom use of virtual worlds in language education remains rare, limiting the opportunities that language learners have to access this beneficial technology.

As one approach to resolving these issues, this study has explored the virtual world Minecraft as an alternative arena for language learning tasks. The investigation progressed in three phases: First, a small pilot study described in Chapter 4 was conducted to provide an initial assessment of Minecraft's suitability as platform for developing communicative tasks and for using such tasks with language learners. Results of the pilot study, which were positive, were used to inform a larger investigation, described in Chapters 5 and 6, that constituted the second phase of the investigation. The larger study provided similarly positive results and demonstrated Minecraft's potential as an alternative virtual world for language learning programs. The third phase of the investigation, described in Chapter 7, explored the attitudes of university language teachers in Japan to reveal what challenges may still exist to the effective incorporation of virtual worlds in language learning programs.

In the main study, five goal-orientated communicative tasks were explored in the MinecraftEDU variant of Minecraft, and findings indicated that the tasks were feasible to implement on the part of the researcher and were solvable by learners unfamiliar with Minecraft through cooperative interaction. The tasks themselves were rooted in the traditional TBLT hierarchy of Pica et al. (1993), but were designed to leverage the creative affordances of Minecraft's particular blocks-world environment. Discourse analysis of the transcript data in Chapter 5 focused on examples of five categories of significant learner interaction: interaction directed at the maintenance of intersubjectivity, interaction related to understanding learner roles and the task objectives, interaction arising directly from task objectives, interaction arising from the broader ecology of the learning environment, and interaction that specifically bridged both the physical and virtual spaces. For each category, multiple examples of negotiation of meaning were presented and carefully analyzed, providing evidence that each of the tasks had functioned as intended and

that the overall study environment was supportive of language learning and the development of communicative competence. It was additionally noted that the participants displayed a very high level of autonomy during the task completion, and incidence of L1 usage was low. The evaluation of learner attitudes in Chapter 6 demonstrated through an analysis of Likert item responses and responses to post-study semi-structured interview questions that the study participants had a positive disposition toward Minecraft and the implemented tasks, that the environment benefited the participants' willingness to communicate, that the learners were aware that they had employed a range of successful communication strategies, and that the learners were likely open to the integration of Minecraft-based communicative tasks in university language learning programs.

Returning to the research agenda outlined in Section 3.3, the results summarized above represent a positive finding for the first three research questions: The usability applicability of Minecraft to goal-orientated tasks was clearly demonstrated, the type and frequency of negotiation of meaning elicited by the tasks were both shown to be robust, and the attitudes of the learners were shown to be positive.

The final research question, regarding the attitudes of university language teachers in Japan and the obstacles to classroom use of these technologies, was addressed in Chapter 7. The survey and interviews conducted in the final study demonstrated that both educators who had used digital games or virtual worlds in classrooms and educators who had never used these technologies with students agreed that the technologies were beneficial for language learners. However, there was also broad agreement that the technological hurdles of existing solutions were prohibitively high, and that university administrators and IT support staff would take an unfavorable view of any instructor-initiated attempts to integrate such

technologies into classroom use. Thus, as mentioned, actual classroom use of virtual worlds remains rare.

8.2 LIMITATIONS

As with much research in SLA, the findings presented here are not definitive and must be considered in conjunction with the studies' limitations. The key limitations arise from the small number of tasks considered in both the pilot and main studies, and the constraint that the tasks were designed to be completed by the end of 90-minute sessions. Additionally, three of the five tasks in the main study were primarily concerned with building, resulting in much of the interaction centering around where and how to place specific kinds of material in the environment. Future work holds possibilities for exploring more elaborate, collaborative projects that extend over multiple sessions and that can take advantage of learners' increasing proficiency with the virtual world. Finally, Minecraft has already been adopted as an early test case for an augmented reality platform (Summers, 2015), and so the clear separation between physical and virtual space that was distinguished in this study may, by design, become obscured in future versions of the software, having a potentially profound impact on the nature of learner interaction in these mixed environments.

Further limitations of this work relate to the restricted diversity of the participants, as 13 of the 15 participants in the main study were born in Japan and were native speakers of Japanese, and all were students at the same university in Japan. A wider selection of participants from more diverse backgrounds and from a range of academic institutions would also help to ensure more generalizable conclusions. In particular, a larger data source may help to mitigate issues with the reliability of self-reported learner data (Dörnyei, 2007). Similarly, studying the deployment of TBLT tasks in Minecraft by multiple practicing language teachers in

actual teaching contexts would provide evidence beyond what may be concluded from studies implemented by a single researcher, as is the case with this study.

8.3 Future Directions

Can Minecraft be a solution to the challenges facing the use of virtual worlds in language education? This study has shown that features affording high usability of Minecraft, such as the ability to easily host the virtual world on a private local server and for novice users to quickly learn how to take constructive and destructive actions in the environment, make Minecraft a highly effective environment for the development and use of goal-orientated communicative language learning tasks. However, as to the question of whether these features also address the institutional challenges that have faced classroom implementation of virtual worlds, the answer is less conclusive. Minecraft, particularly with the usability enhancements in Microsoft's education edition, is certainly easier to implement in the classroom than Second Life, and now probably meets the level of deployability that is necessary for use in language learning contexts. However, implementation using desktop or laptop computers—as in this study—still requires institutional support which may not be forthcoming without a more significant shift in attitudes.

But promising shifts in both technology and attitudes may be on the horizon. As technology continues to evolve, the idea of providing an immersive virtual space for language learner interaction may very well come to achieve wider acceptance. For instance, innovations such as mobile computing and the bring-your-own-device (BYOD) model, where students use personal computing devices in class, may alleviate some of the challenges associated with centrally administered computer labs, and the more streamlined software typical of mobile devices may help further address technical issues and other barriers to adoption (Godwin-Jones, 2011), although even then some challenges may remain (Gikas & Grant, 2013). In particular, it should be

noted that Minecraft is now also available on the leading mobile operating systems iOS and Android. Additionally, mobile devices also help provide new ways of interacting with virtual features, such as *mixed reality* (Hawkinson et al., 2017), in which virtual reality is combined with the real world. However, regardless of the specific technological details, any innovations in this area that succeed in becoming widely adopted in educational contexts will be those for which the skills and effort required to adopt the innovation do not present significant technological hurdles.

What this study makes abundantly clear is that great potential exists, but that more work is needed to fully understand and realize the benefits that virtual worlds can offer language learners. Research findings in this area and the experiences of educators who have adopted these techniques will continue to inform future efforts. As technology and attitudes continue to evolve, an exciting future awaits.

REFERENCES

Abbuhl, R., & Mackey, A. (2017). Second language acquisition research methods. In *Research Methods in Language and Education* (pp. 183–193). Springer International Publishing. https://doi.org/10.1007/978-3-319-02249-9_13

Antón, M., & Dicamilla, F. J. (1999). Socio-cognitive functions of L1 collaborative interaction in the L2 classroom. *The Modern Language Journal*, *83*(2), 233–247. https://doi.org/10.1111/0026-7902.00018

Bachman, L. F. (2004). *Statistical Analyses for Language Assessment*. Cambridge University Press.

Bachnik, J. (2003). *Roadblocks on the information highway: The IT revolution in Japanese education*. Lexington Books.

Bayliss, J. D. (2012). Teaching game AI through Minecraft mods. *2012 IEEE International Games Innovation Conference*, 1–4. https://doi.org/10.1109/IGIC.2012.6329841

Blake, R. (2000). Computer mediated communication: A window on L2 Spanish interlanguage. *Language Learning and Technology*, *4*(1), 120–136. https://doi.org/10125/25089

Blasing, M. T. (2010). Second language in Second Life: Exploring interaction, identity and pedagogical practice in a virtual world. *Slavic and East European Journal*, *54*(1), 96–117. https://www.jstor.org/stable/23345003

Bulkot, M. (2015). Using MinecraftEdu to establish common ground and increase collaboration in an American literature college course [State University of New York Polytechnic Institute]. In *School of Information Design and Technology*. https://dspace.sunyconnect.suny.edu/bitstream/handle/1951/66521/IDTThesisBulkotMary.pdf

Butler-Pascoe, M. E. (2011). The history of CALL. *International Journal of Computer-Assisted Language Learning and Teaching*, *1*(1), 16–32. https://doi.org/10.4018/ijcallt.2011010102

Bygate, M., Skehan, P., & Swain, M. (2001). *Researching pedagogic tasks: Second language learning, teaching, and testing*. Pearson.

Bytheway, J. (2019). In-game culture affects learners' use of vocabulary learning strategies in massively multiplayer online role-playing games. In *Computer-Assisted Language Learning* (Vol. 4, Issue 4, pp. 1218–1231). IGI Global. https://doi.org/10.4018/978-1-5225-7663-1.ch058

Canto, S., & Jauregi Ondarra, K. (2017). Language learning effects through the integration of synchronous online communication: The case of video communication and Second Life. *Language Learning in Higher Education*, *7*(1), 21–53. https://doi.org/10.1515/cercles-2017-0004

Chen, J. C. (2016a). EFL learners' strategy use during task-based interaction in Second Life. *Australasian Journal of Educational Technology*, *32*(3), 1–17. https://doi.org/10.14742/ajet.2306

Chen, J. C. (2016b). The crossroads of English language learners, task-based instruction, and 3D multi-user virtual learning in Second Life. *Computers & Education*, *102*, 152–171. https://doi.org/10.1016/j.compedu.2016.08.004

Chen, J. C., & Kent, S. (2020). Task engagement, learner motivation and avatar identities of struggling English language learners in the 3D virtual world. *System*, *88*, 102168. https://doi.org/10.1016/j.system.2019.102168

Chik, A. (2012). Digital gameplay for autonomous foreign language learning: Gamers' and language teachers' perspectives. In H. Reinders (Ed.), *Digital Games in Language Learning and Teaching* (pp. 95–114). Palgrave Macmillan UK. https://doi.org/10.1057/9781137005267_6

Chun, D. (2016). The role of technology in SLA research. *Language Learning & Technology*, *20*(2), 98–115. http://dx.doi.org/10125/44463

Collentine, K. (2011). Learner autonomy in a task-based 3D world and production. *Language Learning & Technology*, *15*(3), 50–67. http://dx.doi.org/10125/44262

Cooke-Plagwitz, J. (2013). New directions in CALL. *CALICO Journal*, *25*(3), 547–557. https://doi.org/10.1558/cj.v25i3.547-557

Deutschmann, M., & Panichi, L. (2009). Talking into empty space? Signalling involvement in a virtual language classroom in Second Life. *Language Awareness*, *18*(3–4), 310–328. https://doi.org/10.1080/09658410903197306

Deutschmann, M., Panichi, L., & Molka-Danielsen, J. (2009). Designing oral participation in Second Life – a comparative study of two language proficiency courses. *ReCALL*, *21*(02), 206. https://doi.org/10.1017/S0958344009000196

Dörnyei, Z. (2007). *Research Methods in Applied Linguistics*. Oxford University Press.

Duncan, S. C. (2011). Minecraft, beyond construction and survival. *Well Played: A Journal on Video Games, Value and Meaning*, *1*(1), 1–22. https://doi.org/10.1184/R1/10029221.v1

DuQuette, J.-P. (2011a). Task-based learning and teaching in online virtual worlds and games. *OnTask: The Journal of the JALT Task-Based Learning SIG*, *1*(2), 4–15.

DuQuette, J.-P. (2011b). Buckling down: Initiating an EFL reading circle in a casual online learning group. *The JALT CALL Journal*, *7*(1), 79–92. https://doi.org/10.29140/jaltcall.v7n1.109

DuQuette, J.-P., & Hann, F. (2010). Using tasks in virtural worlds. *Temple University Japan: Working Papers in Applied Linguistics*, *23*, 19–26.

Educational Testing Service. (2007). *The TOEIC listening and reading score descriptors*. https://www.ets.org/content/dam/ets-org/pdfs/toeic/toeic-listening-reading-score-descriptors.pdf

Educational Testing Service. (2014). *A guide to understanding TOEFL iBT scores*. https://www.ets.org/toefl/score-users/ibt/interpret-scores.html

Ellis, R. (2003). *Task-based language learning and teaching*. Oxford University Press.

Ellis, R., & Shintani, N. (2014). *Exploring language pedagogy through second language acquisition research*. Routledge.

Franciosi, S. J. (2016). Acceptability of RPG simulators for foreign language training in Japanese higher education. *Simulation & Gaming*, *47*(1), 31–50. https://doi.org/10.1177/1046878115608621

Gee, J. P. (2014). Unified discourse analysis: Language, reality, virtual worlds and video games. In *Unified Discourse Analysis: Language, Reality, Virtual Worlds and Video Games*. Routledge. https://doi.org/10.4324/9781315774459

Gikas, J., & Grant, M. M. (2013). Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media. *The Internet and Higher Education*, *19*, 18–26. https://doi.org/10.1016/j.iheduc.2013.06.002

Godwin-Jones, R. (2011). Mobile apps for language learning. *Language Learning & Technology*, *15*(2), 2–11. http://dx.doi.org/10125/44244

Graham, S. (2022). Self-efficacy and language learning – what it is and what it isn't. *The Language Learning Journal*, *50*(2), 186–207. https://doi.org/10.1080/09571736.2022.2045679

Halliday, M. (1973). *Explorations in the functions of language*. Edward Arnold.

Hampel, R. (2006). Rethinking task design for the digital age: A framework for language teaching and learning in a synchronous online environment. *ReCALL*, *18*(01), 105. https://doi.org/10.1017/S0958344006000711

Hampel, R. (2010). Task design for a virtual learning environment in a distant language course. In Michael Thomas & H. Reinders (Eds.), *Task-based language learning and teaching with techology* (pp. 131–153). Continuum.

Hashemi, M. R., & Babaii, E. (2013). Mixed methods research: Toward new research designs in applied linguistics. *The Modern Language Journal*, *97*(4), 828–852. https://doi.org/10.1111/j.1540-4781.2013.12049.x

Hausrath, Z. (2012). Minecraft. *Electronic Journal for English as a Second Language (TESL-EJ)*, *15*(4). https://tesl-ej.org/wordpress/issues/volume15/ej60/ej60m1/

Hawkinson, E., Mehran, P., & Alizadeh, M. (2017). Using MAVR to bring new dimensions to the classroom. *The Language Teacher*, *41*(3), 30–32. https://doi.org/10.37546/JALTTLT41.3

Henderson, M., Huang, H., Grant, S., & Henderson, L. (2012). The impact of Chinese language lessons in a virtual world on university students' self-efficacy beliefs. *Australasian Journal of Educational Technology*, *28*(3), 400–419. https://doi.org/10.14742/ajet.842

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. https://doi.org/10.11139/cj.31.1.19-39

Hung, H.-T., Yang, J. C., Hwang, G.-J., Chu, H.-C., & Wang, C.-C. (2018). A scoping review of research on digital game-based language learning. *Computers &*

Education, *126*, 89–104. https://doi.org/10.1016/j.compedu.2018.07.001

Hymes, D. (1971). *On communicative competence*. University of Pennsylvania Press.

Jauregi, K., Canto, S., de Graaff, R., Koenraad, T., & Moonen, M. (2011). Verbal interaction in Second Life: Towards a pedagogic framework for task design. *Computer Assisted Language Learning*, *24*(1), 77–101. https://doi.org/10.1080/09588221.2010.538699

Jee, M. J. (2014). From first life to Second Life: Evaluating task-based language learning in a new environment / De la vie réelle à la vie virtuelle: évaluation de l'apprentissage des langues basé sur les tâches dans un nouvel environnement. *Canadian Journal of Learning and Technology / La Revue Canadienne de l'apprentissage et de La Technologie*, *40*(1), 1–15. https://doi.org/10.21432/T2F595

Krashen, S. (1977). Some issues relating to the monitor model. *Teaching and Learning English as a Second Language: Trends in Research and Practice: On TESOL '77: Selected Papers from the Eleventh Annual Convention of Teachers of English to Speakers of Other Languages*, 144–158.

Krashen, S. (1985). The input hypothesis: Issues and implications. In *The Input Hypothesis: Issues and Implications*. Longman.

Krashen, S., & Terrell, T. (1983). *The natural approach: Language acquisition in the classroom*. Pergamon.

Kuhn, J., & Stevens, V. (2017). Participatory culture as professional development: Preparing teachers to use *Minecraft* in the classroom. *TESOL Journal*, *8*(4), 753–767. https://doi.org/10.1002/tesj.359

Lafford, B. A. (2007). Second language acquisition reconceptualized? The impact of Firth and Wagner (1997). *The Modern Language Journal*, *91*(5), 735–756. https://doi.org/10.1111/j.1540-4781.2007.00666.x

Lai, C., Ni, R., & Zhao, Y. (2013). Digital games and language learning. In M Thomas, H. Reinders, & M. Warschauer (Eds.), *Contemporary Computer-Assisted Language Learning* (pp. 183–200). Bloomsbury.

Lan, Y.-J., Kan, Y.-H., Sung, Y.-T., & Chang, K.-E. (2016). Oral-performance language tasks for CSL beginners in Second Life. *Language Learning & Technology*, *20*(3), 60–79. http://dx.doi.org/10125/44482

Lan, Y. J. (2015). Contextual EFL learning in a 3D virtual environment. *Language Learning & Technology*, *19*(2), 16–31. http://dx.doi.org/10125/44412

Lee, Y. J., & Gerber, H. (2013). It's a WoW world: Second language acquisition and massively multiplayer online gaming. *Multimedia-Assisted Language Learning*, *16*(2), 53–70. https://doi.org/10.15702/mall.2013.16.2.53

Leeming, P. (2017). A longitudinal investigation into English speaking self-efficacy in a Japanese language classroom. *Asian-Pacific Journal of Second and Foreign Language Education*, *2*(1), 12. https://doi.org/10.1186/s40862-017-0035-x

Levak, N., & Son, J. B. (2016). Facilitating second language learners' listening comprehension with Second Life and Skype. *ReCALL*, *29*(2), 200–218. https://doi.org/10.1017/S0958344016000215

Levin, J. (2016). Minecraft & Minecraft: Education Edition. In *The Minecraft Teacher*. https://minecraftteacher.tumblr.com/post/137657212625/minecraftedu-minecraft-education-edition

Liang, M.-Y. (2012). Foreign ludicity in online role-playing games. *Computer Assisted Language Learning*, *25*(5), 455–473. https://doi.org/10.1080/09588221.2011.619988

Linden, J. (2018). *Build tools - English*. Second Life Community Knowledge Base. https://community.secondlife.com/knowledgebase/english/build-tools-r12/

Liou, H.-C. (2012). The roles of Second Life in a college computer-assisted language learning (CALL) course in Taiwan, ROC. *Computer Assisted Language Learning*, *25*(4), 365–382. https://doi.org/10.1080/09588221.2011.597766

Long, M. H. (1981). Input, interaction, and second-language acquisition. *Annals of the New York Academy of Sciences*, *379*(1 Native Langua), 259–278. https://doi.org/10.1111/j.1749-6632.1981.tb42014.x

Long, M. H. (1985). A role for instruction in second language acquisition. In K. Hyltenstam & M. Pienemann (Eds.), *Modelling and Assessing Second Language Acquisition*. Multilingual Matters.

Long, M. H. (1996). The role of linguistic environment in second language acquisition. In W. Ritchie & T. Bhatia (Eds.), *Handbook of Research on Language Acquisition Vol. 2: Second language acquisition* (pp. 413–468). Academic Press.

McCroskey, J. C., & Baer, J. E. (1985). Willingness to communicate: The construct and its measurement. *Proceedings of the Annual Meeting of the Speech Communication Association*, 1–9. https://files.eric.ed.gov/fulltext/ED265604.pdf

Melchor-Couto, S. (2017). Foreign language anxiety levels in Second Life oral interaction. *ReCALL*, *29*(1), 99–119. https://doi.org/10.1017/S0958344016000185

Miller, M., & Hegelheimer, V. (2006). The SIMs meet ESL: Incorporating authentic computer simulation games into the language classroom. *Interactive Technology and Smart Education*, *4*(4), 311–328. https://doi.org/10.1108/17415650680000070

Milton, J., Jonsen, S., Hirst, S., & Lindenburn, S. (2012). Foreign language vocabulary development through activities in an online 3D environment. *The Language Learning Journal*, *40*(1), 99–112. https://doi.org/10.1080/09571736.2012.658229

Muffett, T. (2014, June 20). Should teachers use Minecraft in our classrooms? *BBC News*. https://www.bbc.com/news/av/education-27936946

Nunan, D. (2004). *Task-based language teaching*. Cambridge University Press.

Pardo, R., Kaplan, J., & Chilton, T. (2004). *World of Warcraft*. Blizzard Entertainment. https://worldofwarcraft.com/

Pattison, P. (1987). *Developing communication akills*. Cambridge University Press.

Persson, M., & Bergensten, J. (2009). *Minecraft*. Mojang Studios. https://www.minecraft.net

Peterson, M. (2005). Learning interaction in an avatar-based virtual environment: A preliminary study. *PacCALL Journal*, *1*(1), 29–40.

Peterson, M. (2006). Learner interaction management in an avatar and chat-based virtual world. *Computer Assisted Language Learning*, *19*(1), 79–103. https://doi.org/10.1080/09588220600804087

Peterson, M. (2008). Virtural worlds in language education. *JALT CALL Journal*, *4*(3), 29–37. https://doi.org/10.29140/jaltcall.v4n3.67

Peterson, M. (2010). Learner participation patterns and strategy use in Second Life: An exploratory case study. *ReCALL*, *22*(3), 273–292. https://doi.org/10.1017/S0958344010000169

Peterson, M. (2011). Toward a research agenda for the use of three-dimensional virtual worlds in language learning. *CALICO Journal*, *29*(1), 67–80. https://doi.org/10.11139/cj.29.1.67-80

Peterson, M. (2012a). EFL learner collaborative interaction in Second Life. *ReCALL*, *24*(1), 20–39. https://doi.org/10.1017/S0958344011000279

Peterson, M. (2012b). Learner interaction in a massively multiplayer online role playing game (MMORPG): A sociocultural discourse analysis. *ReCALL*, *24*(3), 361–380. https://doi.org/10.1017/S0958344012000195

Peterson, M. (2013). Computer games and language learning. In Michael Thomas, J. P. Gee, & J. Palfrey (Eds.), *Digital Education and Learning*. Palgrave Macmillan.

Peterson, M. (2016). Virtual worlds and language learning. In F. Farr & L. Murray (Eds.), *Routledge Handbook of Language Learning and Technology* (pp. 308–319).

Peterson, M. (2017). Introduction. In M. Peterson (Ed.), *Digital Language Learning and Teaching: Critical and Primary Sources, Vol. IV: New Developments in Computer Assisted Language Learning* (pp. 1–18). Bloomsbury.

Petrov, A. (2014). *Using Minecraft in education: A qualitative study on benefits and challenges of game-based education* [University of Toronto]. https://hdl.handle.net/1807/67048

Pica, T. (1987). Second-language acquisition, social interaction, and the classroom. *Applied Linguistics*, *8*(1), 3–21. https://doi.org/10.1093/applin/8.1.3

Pica, T. (1994). Research on negotiation: What does it reveal about second-language learning conditions, processes, and outcomes? *Language Learning*, *44*(3), 493–527. https://doi.org/10.1111/j.1467-1770.1994.tb01115.x

Pica, T., Kanagy, R., & Falodun, J. (1993). Choosing and using communication tasks for second language research and instruction. In G. Crookes & S. Gass (Eds.), *Tasks and second language learning* (pp. 9–34). Multilingual Matters.

Prabhu, N. S. (1987). *Second language pedagogy*. Oxford University Press.

Quarnstrom, D. (2017). *Minecraft: Education Edition reaches a milestone of two million users and releases new Hour of Code tutorial*. Windows Blogs. https://blogs.windows.com/windowsexperience/2017/11/14/

Rama, P. S., Black, R. W., Van Es, E., & Warschauer, M. (2012). Affordances for second language learning in World of Warcraft. *ReCALL*, *24*(3), 322–338. https://doi.org/10.1017/S0958344012000171

Ranalli, J. (2008). Learning English with The Sims: exploiting authentic computer simulation games for L2 learning. *Computer Assisted Language Learning*, *21*(5), 441–455. https://doi.org/10.1080/09588220802447859

Rankin, Y. A., & Shute, M. W. (2010). Re-purposing a recreational video game as a serious game for second language acquisition. In J. Cannon-Bowers & C. Bowers (Eds.), *Serious game design and development: Technologies for training and learning* (pp. 179–195). IGI Global.

Reinders, H., & Wattana, S. (2011). Learn English or die: The effects of digital games on interaction and willingness to communicate in a foreign language. *Digital Culture & Education*, *3*(1), 4–28. https://doaj.org/article/26da2588091545c4a505cb6aaa2dca80

Reinders, H., & Wattana, S. (2014). Can I say something? The effects of digital game play on willingness to communicate. *Language Learning & Technology*, *18*(2), 101–123. http://dx.doi.org/10125/44372

Reinders, H., & Wattana, S. (2015). Affect and willingness to communicate in digital game-based learning. *ReCALL*, *27*(1), 38–57. https://doi.org/10.1017/S0958344014000226

Reinhardt, J., & Sykes, J. M. (2012). Conceptualizing digital game-mediated L2 learning and pedagogy: Game-enhanced and game-based research and practice. In H. Reinders (Ed.), *Digital games in language learning and teaching* (pp. 32–49). Palgrave Macmillan.

Rich, S. (2016). Exploring critical thinking and negotiation of meaning through MinecraftEDU: A case study of elementary language learners [Boise State University]. In *Educational Technology*. https://scholarworks.boisestate.edu/td/1112

Richards, J. (2001). *Curriculum development in language teaching*. Cambridge University Press.

Rosedale, P. (2003). *Second Life*. Linden Lab. https://secondlife.com/

Sadler, R. (2012). *Virtual worlds for language learning: From theory to practice*. Peter Lang.

Sadler, R., & Dooly, M. (2013). Language learning in virtual worlds: Research and practice. In M Thomas, H. Reinders, & M. Warschauer (Eds.), *Contemporary Computer-Assisted Language Learning* (pp. 159–182).

Schifter, C., & Cipollone, M. (2013). Minecraft as a teaching tool: One case study. In R. McBride & M. Searson (Eds.), *Society for Information Technology & Teacher Education International Conference 2013* (pp. 2951–2955). AACE. https://www.learntechlib.org/primary/p/48540/

Schwienhorst, K. (2002). Why virtual, why environments? Implementing virtual reality concepts in computer-assisted language learning. *Simulation & Gaming*,

33(2), 196–209. https://doi.org/10.1177/104687810233200

Short, D. (2012). Teaching scientific concepts using a virtual world - Minecraft. *Teaching Science*, *58*(3), pp 55-58. https://www.learntechlib.org/p/91796

Smith, B. (2003). Computer-mediated negotiated interaction: An expanded model. *The Modern Language Journal*, *87*(1), 38–57. https://doi.org/10.1111/1540-4781.00177

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. https://doi.org/10.1111/j.1365-2729.2010.00353.x

Swier, R. (2014). Tasks for easily modifiable virtual environments. *JALT CALL Journal*, *10*(3), 203–219. https://doi.org/10.29140/jaltcall.v10n3.176

Swier, R., & Peterson, M. (2018). 3D digital games, virtual worlds, and language learning in higher education: Continuing challenges in Japan. *JALT CALL Journal*, *14*(3), 225–238. https://doi.org/10.29140/jaltcall.v14n3.232

Sykes, J. M., Oskoz, A., & Thorne, S. L. (2008). Web 2.0, synthetic immersive environments, and mobile resources for language education. *CALICO Journal*, *25*(3), 528–546. https://doi.org/10.1558/cj.v25i3.528-546

Sykes, J. M., Reinhardt, J., & Thorne, S. L. (2010). Multiuser digital games as sites for research and practice. In F. M. Hult (Ed.), *Directions and Prospects in Educational Linguistics* (pp. 117–135). Springer.

Thorne, S. L. (2008). Transcultural communication in open internet environments and massively multiplayer online games. In S. Magnan (Ed.), *Mediating Discourse Online* (pp. 305–327). John Benjamins.

Thorne, S. L., Black, R. W., & Sykes, J. M. (2009). Second language use, socialization, and learning in internet interest communities and online gaming. *The Modern Language Journal*, *93*(Focus Issue). https://doi.org/10.1111/j.1540-4781.2009.00974.x

Toyoda, E., & Harrison, R. (2002). Categorization of text chat communication between learners and native speakers of Japanese. *Language Learning and Technology*, *6*(1), 82–99. http://dx.doi.org/10125/25144

Uusi-Mäkelä, M. (2015). *Learning English in Minecraft: A case study on language competences and classroom practices*. University of Tampere.

Vygotsky, L. S. (1978). *Mind and society*. Harvard University Press.

Wang, A., Deutschmann, M., & Steinvall, A. (2013). Towards a model for mapping participation: Exploring factors affecting participation in a telecollaborative learning scenario in Second Life. *JALT CALL Journal*, *9*(1), 3–22. https://doi.org/10.29140/jaltcall.v9n1.146

Wang, X. C., Calandra, B., Hibbard, S. T., & McDowell-Lefaiver, M. L. (2012). Learning effects of an experimental EFL program in Second Life. *Educational Technology Research & Development*, *60*(5), 943–961. https://doi.org/10.1007/s11423-012-9259-0

Warschauer, M. (1997). Computer-mediated collaborative learning: Theory and practice. *The Modern Language Journal*, *81*(4), 470–481. https://doi.org/10.1111/j.1540-4781.1997.tb05514.x

Wehner, A. K., Gump, A. W., & Downey, S. (2011). The effects of Second Life on the motivation of undergraduate students learning a foreign language. *Computer Assisted Language Learning*, *24*(3), 277–289. https://doi.org/10.1080/09588221.2010.551757

Wiggins, B. E. (2016). An overview and study on the use of games, simulations, and gamification in higher education. *International Journal of Game-Based Learning*, *6*(1), 18–29. https://doi.org/10.4018/IJGBL.2016010102

Wigham, C. R., & Chanier, T. (2013). A study of verbal and nonverbal communication in Second Life—the ARCHI21 experience. *ReCALL*, *25*(1), 63–84. https://doi.org/10.1017/S0958344012000250

Yamazaki, K. (2018). Computer-assisted learning of communication (CALC): A case study of Japanese learning in a 3D virtual world. *ReCALL*, *30*(2), 214–231. https://doi.org/10.1017/S0958344017000350

Yang, H., Tsung, L., & Cao, L. (2022). The Use of Communication Strategies by Second Language Learners of Chinese in a Virtual Reality Learning Environment. *SAGE Open*, *12*(4). https://doi.org/10.1177/21582440221141877

York, J. (2014). Minecraft and language learning. In C. Gallagher (Ed.), *Minecraft in the classroom: Ideas, inspiration, and student projects for teachers*. Peachpit.

Zhao, Y., & Lai, C. (2009). MMORPGs and foreign language education. In R. E. Ferdig (Ed.), *Handbook of Research on Effective Electronic Gaming in Education* (pp. 402–421). IDEA Group.

Zheng, D., Bischoff, M., & Gilliland, B. (2015). Vocabulary learning in massively multiplayer online games: Context and action before words. *Educational Technology Research & Development*, 771–790. https://doi.org/10.1007/s11423-015-9387-4

Zheng, D., Young, M. F., Wagner, M., & Brewer, B. (2009). Negotiation for action: English language learning in game-based virtual worlds. *The Modern Language Journal*, *93*(4), 489–511. https://doi.org/10.1111/j.1540-4781.2009.00927.x

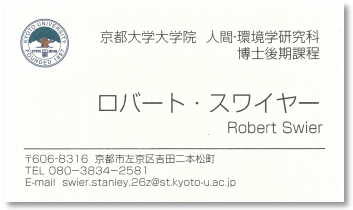
APPENDIX A

Cooperative Language Learning Tasks in Minecraft

Brief Description of Research

In this research, you will play a computer game called Minecraft with a partner or in a small group. Sometimes, you will use a computer by yourself, and sometimes you might share a computer with another student. In any case, you will work with other students to complete some tasks or small projects inside the Minecraft world. The tasks will not very difficult, but you and your partner must help each other and share ideas information in order to complete them successfully.

This research is being conducted by:



Robert Swier
Ph.D Student
Kyoto University
swier.stanley.26z@st.kyoto-u.ac.jp

APPENDIX B

Consent Form For Collection and Publication of Data

Cooperative Language Learning Tasks in Minecraft

I, Robert Swier (swier.stanley.26z@st.kyoto-u.ac.jp), under the supervision of Mark Peterson at Kyoto University, am asking for your voluntary participation in a research study about using computer games for second language learning. In this research, you will complete two short questionnaires, and speak English while playing a computer game with your classmates. Your voice and computer monitor may be recorded during class. This data, along with your written work, may be used in an academic publication; however**, your name and other personal information will be kept private.**

Allowing your data to be used for academic research is completely voluntary. If you decide not to allow your data to be used, there will not be any negative consequences. If you do decide to allow the use of your data, you may change your mind at any time during the course and for any reason. Also, you may choose not to answer any specific questions on the questionnaires.

There are no potential risks or benefits to you by participating in this research or allowing the use of your data for this academic research.

By signing this form, you indicate that you have read and understand the above information, and that you freely consent to allow the anonymous use of your data in academic publications.

Name: _____

Date: _____

APPENDIX C

Questionnaire #1

Please answer the questions below. You may skip any questions that you do not want to answer. Thank you very much for your help.

What is your name?

How old are you?

What is your major/faculty?

Do you have a recent TOEIC or TOEFL score? If so, what is the score?

What country were you born in?

What language or languages do you speak natively?

Have you ever played computer games before? If yes, what kind of games have you played?

APPENDIX D

Tasks

Please read these tasks together with your partner. Your goal is to work together to figure out how to complete the task. If you have a question, you may ask the researcher. Please do the tasks in the order shown below. After you finish the first task, please go on to the next one.

Task 1: The White Player goes up the stairs of the big building with the glass roof. The White Player can see two rooms with many colored blocks—Room A and Room B. The Red Player enters Room B on the ground level. The Red Player must move the blocks in Room B so that they are the same as Room A.

The task is complete when Room A and Room B look the same.

Task 2: There is a nearby town called Fort Wild Horse. Somewhere in Fort Wild Horse, there is a box that contains three pieces of gold. Together with your partner, go find the three pieces of gold in Fort Wild Horse, and bring them back to the home area (starting point). Put them in the box labeled "GOLD" in the home area.

The task is complete when the "GOLD" box in the home area contains three pieces of gold from Fort Wild Horse.

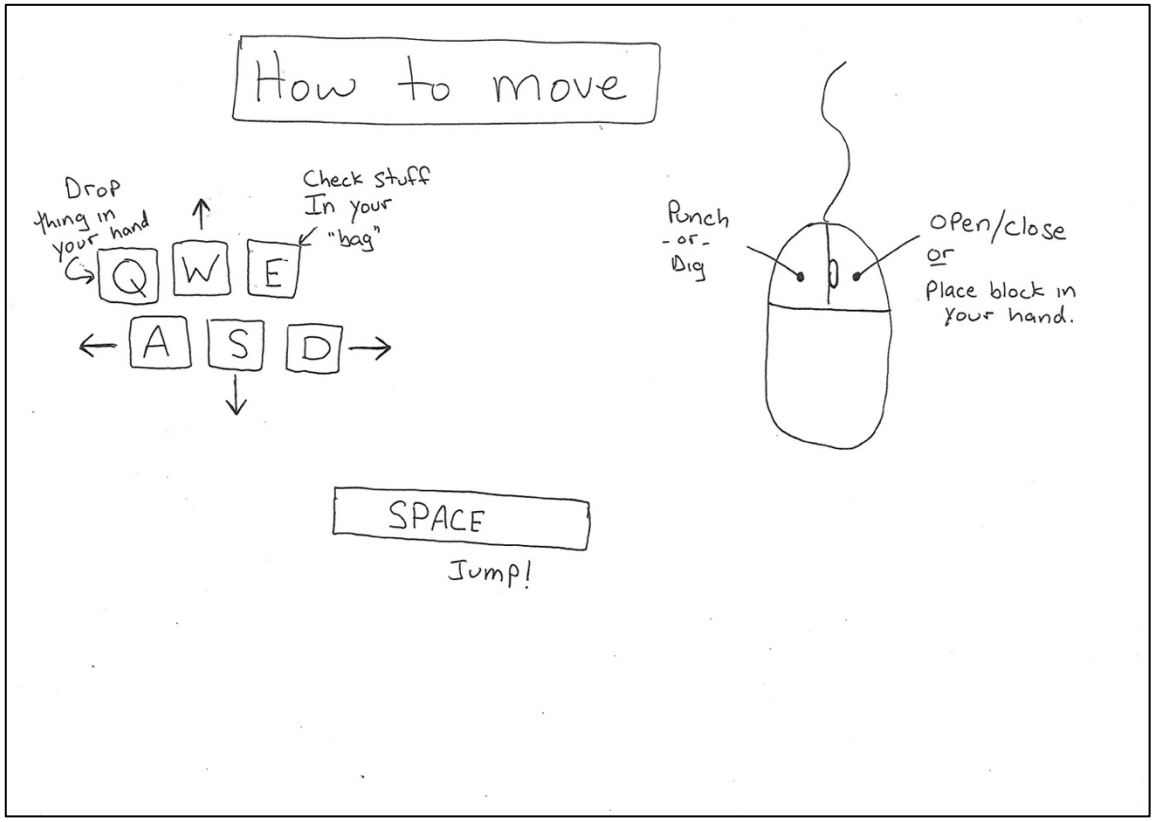
Task 3: You and your partner are going to go on a little adventure. In the last task, you collected some gold from Fort Wild Horse. In this task, you will:

- Go to Diamond Library Village and find the library. In the library, there is a box that contains nine diamonds. Take the diamonds!
- After that, find the path to the Old Castle. In the Old Castle, there is a box that contains two clocks. Take the clocks!
- Next, go to the Old Pyramid. In the Old Pyramid, there is a box with two compasses. Take the compasses! From inside the Old Pyramid, there is a secret tunnel that goes back to the home area. It is very long. Follow the tunnel back to the home area.

Please do each part in the order shown above. Collect all of the items first, and then come back to the home area. Put the diamonds in the "DIAMONDS" box, the clocks in the "CLOCKS" box, and the compasses in the "COMPASSES" box.

The task is complete when all items have been collected and placed in the correct boxes.

Appendix E


How to move
Drop thing in your hand
Check stuff In your "bag"
Q
W
E
A
S
D
SPACE
Jump!
Punch -or- Dig
Open/close or Place block in your hand.

APPENDIX F

Questionnaire #2

Please answer the following questions. You may skip any questions that you do not want to answer. Thank you for participating in this research project.

Name:

1. Your interest level in the English language (circle one):
   - 4 very interested
   - 3 somewhat interested
   - 2 not very interested
   - 1 not at all interested

2. Experience in using computers (circle one):
   - 4 I am very experienced using computers
   - 3 I often use computers
   - 2 I seldom use computers
   - 1 I almost never use computers

3. Have you ever played a multiplayer computer game before? If so, what language did you use (English, Japanese, etc...)?

Answer using one of the following (write a number in the brackets at the end of each sentence):

(5) *strongly agree* (4) *agree* (3) *no opinion* (2) *disagree* (1) *strongly disagree*

4. The game was easy to use ( )

5. The tasks and directions were easy to understand ( )

6. Solving the tasks was easy ( )

7. Traditional classes are more useful than playing this game ( )

8. I could learn new words and expressions by playing this game ( )

9. Playing this game cannot help me improve my English ability ( )

10. Most of the discussion was not very useful ( )

11. I could speak and use English successfully during the game ( )

12. There was not much feedback from the other player ( )

13. In the game, I could speak English more freely than in a regular class ( )

14. Using the game was more interesting than a regular class ( )

15. I enjoyed using the game ( )

16. I would like to play this game again in the future ( )

If you have any other comments about the above questions please write them below:

20. Were there any good points about the game?

21. Were there any problems?

22. Did you feel more comfortable using the game by the end of the session?

23. Could this game help you improve your English ability? If so, how could it help?

25. Did you use any dictionaries or translation software during the game? If so, were these helpful for you?

26. During the game, when you did not understand your partner, what did you do?

31. What was the hardest part about playing this game?

32. Is there anything you would like to tell the researcher about your experiences of using the game?

APPENDIX G

Pilot study transcript of complete session with Student 1 (male, 29) and Student 2 (male, 19).

S1: Student 1
S2: Student 2
R: Researcher

Both players begin by entering Room B. One of the players is not supposed to enter that room, according to the task.

R: Please look at Task #1, and when you are ready, please begin.
S2: <reading> The white player goes up the stair of the big building with the grass roof.
I don't have grass… <starts collecting grass…>
R: Glass.
S2: Glass?
R: Look, it's the building in front of you. The first task is in the building in front of you.
S2: Room M. Many colored box…
S1: You shouldn't enter Room B.
S2: Here is not B?
S1: Maybe this is Room B, so you shouldn't enter here.
S2: Yeah? I entered here?
S1: Yeah. You can enter both of them, maybe.
R: The White Player must go to the top.
S2: Ah. Here is a step. This one? Ah, I find Room A.
S1: I have to make Room B same as Room A. But I cannot enter Room A, so please tell me…
S2: Okay…
Hmm…
S1: There are many colored blocks in Room B…
S2: I'm sorry. I broke white blocks in Room B.
R: It's okay. I replaced it.
S2: Okay. Thank you.
All: <laughter>
S2: Side of the door in Room B…
S1: MmmHmm…
S2: …you put orange and pink box.
S1: Orange and pink?
S2: Yeah.
S1: Okay.
S2: And, uh, orange is left… umm… orange is right and pink is left.
S1: Okay. Is it near the door?
S2: Near door.
S1: Orange is left and pink is right?
S2: Yeah.
S1: Okay. Thank you. Uh, I put these blocks besides the door of Room B.
S2: Um, maybe go little, um…
S1: Far from the door?
S2: A little far… Orange and pink box are a little far from door.
S1: Does pink block touch the wall?
S2: Yeah, both…
Can you look me?
Hey… <greeting, as in hey, look at me…>
S1: Ah! You can see me?
S2: Uh, Under me, you put the orange boxes.
S1: Okay.
S2: Under me, you…
S1: <To teacher> Is it okay to do like that?
R: <Yes>
S2: I think it's very cheat…
R: <No…>
S2: Okay.
Under me…
Go straight to the, uh…
From me…
S1: Do you mean…
What color?
S2: Please wait. Let me look.
Next is red and white.
S1: Red and white?
Now I have red block.
S2: Near the Room A. Side of the pink side… pink side wall…
S1: Pink side wall?
S2: Pink side of wall…
S1: Do you mean pink block?
S2: Yeah. Pink block this side wall.

S1: Do you mean this? <refer to location>
S2: No no no no...
Left… left wall
S1: Left?
I don't know which direction you mean.
S2: Uh, sorry. For you, back wall. Back.
S1: Go straight…
S2: Maybe there you have to put the red box. On the wall.
S1: On the wall. Okay.
S2: And next to red box, you have to take the white box.
S1: Okay. Uh, right or left?
S2: Ah, white.
S1: Right?
S2: Yeah, right.
Next is black and blue box.
S1: Okay.
S2: And for you, on the right? Right wall…
S1: Right wall?
S2: Yeah, maybe there you have to put the black box.
S1: Okay.
S2: And next, blue box, under that fire.
S1: Under the fire? Okay.
S2: Next is purple and green. In front of you, under the fire, green boxes.
S1: Left or right fire?
S2: Left fire. Ah, for you… I'm sorry I'm sorry for you…
S1: Right?
S2: Yeah, right box. Uh, right fire.
And left fire, under left fire…
S1: Purple.
Here is purple?
S2: Yeah.
S1: Okay?
S2: Maybe.
S1: Check it. Check Room A and make sure this is the same.
S2: Ah, all boxes have to under fire.
S1: Ah, okay.
S2: Sorry. <apologetic laughter>
S1: You mean like this? <starts moving the blocks so that they are placed under the torches>
S2: Yes, yes. Sorry.
Player A finishes repositioning the blocks
It's okay. It is same room that… I mean, Room A.
S1: Okay. Now we seem to have done the task.
R: Very good. Thank you very much. So, if you don't mind, can you go on to Task #2?
S1: Okay.
R: Task #2 and 3 are a little bit different from that one. So, please read the task. If you have a question, let me know. Maybe you need to read it together and talk about it. If you have a question, let me know. But basically, I'd like you to read the task and try to do it.
S1: Okay.
S2: I have to find… where the…
S1: So, we have to find where Fort Wild Horse is. The town.
S2: Fort Wild Horse, we have to find.
S1: Yes.
S2: I go there.
S1: Yes?
S2: I find… I research there. Where, where… where, where…
S1: Do you know where it is?
S2: I'm nearby a pond…
Mr. Bob? We can't break the… uh… the house is in the fence?
S1: Not "house" but "horse".
S2: Horse?
S1: The name of the town. Look at this. "Fort Wild Horse". It's name of the town.
S2: Ah, I'm sorry.
Horse?
R: That's just the name of the town?
S1: Yeah. So we have to find the town.
S2: Town? Maybe we have to go the high place…
S1: Ah yes. I will go to the top of the mountain and I will look for the town.
S2: I'm worried to fall the place…
S1: Fall? Haha…
S2: Yeah, falling place…
I feel I am a monkey.

S1: Now I got to the top of the tower, and I'm looking for the town. I don't know where it is.
S2: In front of you, do you look that very high someone? The mountain…
S1: Yes.
S2: Around then? Around this one?
S1: But I can see there is a fence before the mountain so maybe we cannot go there.
R: The towns are beyond the fence.
S1: Beyond the fence? So we have to… Okay.
S2: Beyond the fence? In the fence?
R: On the other side.
S1: So, we have to go over the fence.
S2: Go over the fence?
S1: Yes. And we have to find how to do it. Maybe we put block before the fence and climb it.
S2: Or dig under the fence.
S1: Under the fence! Ah…
S2: <laughter>
R: Maybe I should give you a hint. The way you go is you follow the railroad tracks.
S1: Railroad tracks. Okay. Follow the railroad tracks.
S2: What's that?
R: Follow the train line.
S2: Train line, yeah?
R: The railroad tracks.
S1: The direction I'm looking at is right direction, maybe.
S2: My right? For me, to right?
S1: No, in front of you. You said we can see the mountain.
S2: Uh…. On the bridge?
S1: Maybe we should cross the bridge? And, there is a railroad…
S2: Okay, let's go there.
S1: Yeah.
S2: I'm going to go there. Can I go…?
S1: Just enter this hole.
S2: I success.
S1: Okay, let's go.
R: I should tell you, there are two sets for railroad tracks.
S1: Railroad tracks?
R: Railroad tracks. There are two sets.
S1: Maybe we should go back to the railroad and follow the road…
<both players go to a railroad track>
This is a railroad, so how about going the other direction?
S2: Ah, two road. Ah, two leg.
S1: Yeah.
S2: One leg.
S1: Ah, this is starting point. Huh?
Ah, I reached starting point of the railroad, so I should go back.
R: It continues on the other side of the bridge.
S1: Ah, okay.
S2: I'm… Now, I'm on the bridge.
S1: Okay.
S2: <finds door mechanism> What's that? What's that? I find the door.
S1: Okay. What is beyond the door?
S2: No, no… one people… have to on the button…
S1: Uh huh….
S2: The door don't open.
S1: Maybe I got the point.
R: Stop.
S2: Stop?
R: Go the other way.
S1: <laughter> Okay.
R: This is Task #2. Stop, stop. This is Task #2. This railroad track is Task 2. You want the other railroad track. There are two tracks. Follow me!
<Note… the researcher made a mistake. The subjects were on the Task 3 track. The Task 2 track was the other track that they had missed…>
Please start here.
S1: <seeing a sign missed earlier> Ah, yes…
<laughter>
S1: To Fort Wild Horse.
S2: My way was not Task 2 way…
Ah… same system <referring to the bridge crossing>
S1: Yeah…
Maybe you can put something here.
S2: I have a lot of block.
S1: Ah, I cannot put anything on it…

S2: I don't know how to put that.
S1: Right click. Right. Right button. Right button of the mouse. And you can put… put the block.
S2: I have a red one…
R: Ah… okay, that didn't work. You destroyed my system.
S1: Ah? Really?
R: Yeah, you just killed my circuit. Stop! Stop, stop, stop, stop! <laughter>
S1: Okay.
S2: I have red one…
R: You don't have to dig. No digging. No punching. Two people can go through.
S1: Okay.
<they both find a way through the door>
S2: I find! I find.
S1: You found gold block?
S2: Yeah, maybe. Oh!
S1: Maybe these animals are horse, so this here is the town.
S2: Where are you?
S1: I'm on the railroad. I just went along the road.
S2: Oh, I find the… I find the… um… house.
S1: House?
S2: It's not…
S1: We have to find three pieces of gold and bring them back to the home area.
S2: Ah, where are you?
S1: I'm on the railroad!
S2: I am near house. Do you…
S1: What do you mean by "house"?
S2: um…
S1: Ah, yeah, there are some houses….
S2: I have red one, red one. And I..
S1: And our task is to find three pieces of gold.
S2: Fort Wild Horse. This is Fort Wild Horse.
S1: Maybe I found a box, like treasure.
S2: Ah, okay. I go. <A holds the door, while B enters)
Three gold I find.
S1: Three pieces?
S2: Yeah. Three pieces.
S1: Get them and let's go back.
S2: Yeah…
S1: Now, in your inventory, there are three gold pieces, right?
S2: What?
S1: Your inventory. I mean, the bag.
S2: Yeah yeah yeah. I have. I my bag there is… there are are
S1: Three gold pieces?
S2: Yeah.
S1: Okay, let's go back to home place. <smashing grass for fun> <laughter>
S1: I got an egg.
S2: <running the wrong way>
Ah, sorry…
I have flower.
S1: I'm hungry. In the real world. <laughter>
S1: I forgot to have lunch.
S2: Really?
S1: Yeah.
S2: I had two sandwiches…
S1: Did you buy it in convenience store?
S2: No, in the Takamatsu Station… the bakery shop.
It's very delicious.
S1: Did you come by train?
S2: Yes…
Uh, where is the gold…
S1: Ah, here. Yeah, it is….
Open by right click.
S2: Right click…
S1: Yes, right button. And, push "E".
S2: Okay, I entered. I entered three.
R: Very good. Thank you. Now, Task #3. This is the last task.
<mumbling while reading the task from session handout…>
S2: Next, we have to go to the… Diamond.
S1: Yeah, Diamond Library Village.
S2: That way… <referring to direction>
S1: Yes.
<player B damages a sign placed in the game by the researcher>
Don't break it…
<laughter>
S2: I'm sorry, I'm sorry. <laughter>

S1: Let's go.
S2: Let's go.
<laughter>
I'm sorry. I'm sorry.
R: It's okay.
S2: What's that? <upon finding a door locking mechanism>
S1: I'm sorry. Okay, let's go.
<players just cooperatively went through a door locking mechanism. This was the same system as in task 1, and they were able to do it this time with very little verbal communication…>
S2: There is the library?
S1: Hmm… I haven't found it yet.
S2: Huh? I got egg…
S1: Congratulation... <laughter>
S2: Oh! Oh…
S1: I arrived the village.
S2: Mushroom? <player B is exploring by himself…>
S1: You have to find library.
S2: Where are you?
S1: At the end of the railroad.
S2: I can't find railroad.
S1: Are you lost?
S2: I lost way.
S1: Did you fall down?
S2: Down?
S1: I mean, did you fall from somewhere?
S2: <Either "yeah" or "no". Unclear. But the player hadn't fallen.)
Huh? Castle? I find a castle.
S1: Castle? I already arrived the village and looking for the library.
S2: Now, you open door?
S1: No… I found some people.
S2: Ah, Okay, okay!
Back you, back you. I am. I find you. Hey!
S1: Yeah. Let's find the… ah! Maybe here is library.
S2: Can I go?
Ahh… a lot of people.
S1: This is… is it this box?
S2: Maybe we have to break that box.
R: <sigh>
S2: Break? Not break…
S1: Hey Bob, when I press the right button, this window will open.
R: Ah, that is not what you are looking for.
<the players have found a crafting table. They are looking for a chest.>
S1: This is not… not…
R: No…
S1: There is a box that contains…
S2: I find that desk… If we on the two desk, maybe someone happen
<the tables are made of pressure plates, which make a sound when clicked, but they are not connected to anything, so clicking them has no effect.>
S1: But I cannot go up to the table.
Ah, now I'm on the…
I cannot go onto this table.
What happens…
They looking at me… <the villages (NPCs) look at the players>
Is this… This is not the library.
S2: Maybe not library.
S1: Ah, maybe here is library.
S2: Ah, yeah.
S1: I found…
Next…
S2: That door very complexly…
I have to here… because I'm on the button.
S1: Ah, here is button!
S2: Yeah…
S1: Okay.
S2: Next is find the person… Old Castle.
S1: You said you find… you found it.
S2: But… where direction? I… I don't know.
S1: Was it big?
S2: In front of me… maybe, maybe this one.
S1: This is… This looks like a mountain.
S2: "Old Castle" (reading from sign…)
S1: Ah, yeah.
S2: Let's go.
S1: Let's go.
<start crossing the bridge…>

Strange animals are swimming in the river.
S2: Can I go there?
Yes I can…
S1: Can you see the castle?
S2: Do you have a (intern)? <not sure about the last word…>
S1: No. I'm looking for the castle.
S2: I am top.
S1: AhhHmm.
S2: I am top of someone.
Ahhhhhhh!
<Player B falls from a high place and dies.>
S1: I found it here…
S2: I'm sorry…
R: You died.
S2: I died.
S1: Died?
R: He died.
S2: I miss..
S1: Can you revive?
R: Yes, hold on.
Wait here. Can you see me?
S1: UmmHmm.
R: Wait next to me.
<To player B> Can you get back to the original place?
S2: Yeah.
R: Go. Go back to where you died. Ah, go to the town.
S2: Yeah. Oh, I can't.
R: I will help you.
S2: Thank you.
R: Wait here.
S1: Okay.
S2: If I can dig, I can only to that door.
R: Just wait. I will help you.
Okay, go ahead.
S2: Thank you.
R: No trouble.
So, you're going to come back to the bridge, right?
S2: Yeah.
R: After that, please follow the same path across the bridge.
S2: Yeah.
R: <to Player A> Where did you go? Where are you?
S1: Ah, I am here. I can see you.
R: Ah!
S1: On the right side of you.
S2: Me?
S1: No no…
R: Ah!
Can you follow me?
S1: Okay.
S2: Hey Bob, I can't… I can't find out…
S1: I'm still looking for you. Now I'm following Bob.
R: Wait here.
S1: Okay.
R: <To Player B> Hey, where are you?
S2: Uh, in the jungle.
R: Follow the track!
S2: I follow it rush, but…
<reading sign> Welcome to Diamond… Diamond village.
Diamond village?
S1: Just follow the railroad, and you will find the village at the end of the railroad.
S2: I am on end, but I can't find…
S1: Really?
S2: Yes.
S1: Maybe on the left side.
S2: Left side?
S1: Yes.
R: You are standing in the village!
S1: The village is… the village is where the library was, and now we are looking for the old castle.
S2: I'm sorry.
S1: And you found the sign to the old castle so, go find the path to the old castle.
S2: I am in the village. It's up?
Mr. Arnold, where is the… I'm under the… I mean, Mr. Bob..
S1: What you should do now is find the sign to the old castle. Do you remember you found the sign. To Old Castle.
S2: Umm… Umm… I go to jungle… In there… That… Ah, okay!
S1: Have you found the sign?
S2: Found the sign.
Where are you in the castle?
S1: I'm not in the castle yet. I'm just waiting.
S2: Do you look me? Can you look?
S1: Mmm… No I can't. So, go ahead.

R: Ah… there's a small point that you both have missed. Those… there are lights. The sign says follow the lights.
S1: Follow the lights?
R: The torches.
S1: Okay.
S2: I have torches.
S1: No no no no…
R: No, I put them there. Follow them!
S2: Ah, okay!
S1: Follow the torches.
R: This is the path. Follow the path. <laughter>
R: This is not the difficult part. This part is just follow the path.
S1: So, follow the torch on the ground.
S2: On the ground…
S1: Maybe you can find maybe torches on the ground.
S2: Yeah.
S1: Ah, now I can find you.
S2: Thank you.
S1: Look at the the left.
S2: Left?
S1: Yeah. Maybe you can find me. I'm jumping.
R: Okay, okay, okay!
S1: So, come here.
S2: But I'm very worry, next my die… I will worry.
S1: Okay, let's follow the torches.
S2: Yeah.
S1: <reading> Follow coastline to old castle.
Follow coastline.
<to Researcher> Is this system actually made for four people?
R: For four people?
S1: For Four people
R: Um, it's a multiplayer game, so you can have many many people play it. You could have one hundred people play it.
S1: MmmHmm. Because I found three switches in front of the door so I thought… cause first it is for four students.
R: Ah! I see. I thought three would be easier to hit.
S1: Ah… <laughter> Yeah, that's right.
This is the old castle.
We have to find a box.
Ah, there is a box.
Next, go to the old pyramid.
Yeah, I already got two clocks, so let's go to the old pyramid. This way. Turn left.
S2: You are near the sea?
S1: Yes.
S2: On the coastline?
S1: Yes, just follow the coastline.
S2: Okay…
S1: Now I've arrived…
S2: Ahh!! <Player B walks into the water>
S1: …the old pyramid
R: Spacebar! Space!
S2: Okay.
It's pretty danger…
R: Something I didn't say was that if you hold the spacebar, you can swim. So, if you go into deep water, you have to hold the spacebar.
<To Player A> That's for your partner. <laughter>
S2: I want to go in the sea, but…
R: Next time.
S2: Yup.
S1: Okay, I've got the two compasses, so... and maybe I found the path to the home town. Here it is. We should go down here.
S2: Oh.
S1: Hey hey, Ah. I thought you would die.
S2: Yeah…
S1: Okay, go. Read the sign. "To home".
<begin long walk through tunnel>
S2: I go back.
I'm very worried we're wrong…
S1: What?
S2: That's a little bit long…
S1: Ah, yes, I think so.
Bob, after you write down our dialogs, can I read it? I want to check what I'm talking.
R: Ahh… sure.

S1: Is it really okay? If there is a problem…
R: No no… no trouble. Let's talk about that later!
S1: Okay! <laughter>
S2: Mr. Bob… We… I broke the wall. Maybe I'm going back…
S1: What do you think?
S2: Maybe.
S1: Okay.
S2: If I break the, uh, wall…
S1: That… can be broken?
S2: It's made out of rock. It takes a long time to break rock.
S1: Is the point of this game making your own world?
R: Um, yeah. Basically, you can create things, do many things, that's the fun part about it.
S1: MmmHmm.
R: It's very easy to build things.
S2: Yeah.
R: And… destroy them!
<laughter>
S2: But maybe some evil students break everything. Like me…
R: That's okay. Some things I want you to break.
S2: What's that?
R: That's lava. It's very hot.
S1: Hot enough to die?
R: Yeah. It will kill you if you go inside.
S1: Ahh.
I cannot go up.
R: Space.
S1: Hold space…
S2: What's that?
R: You died.
S2: Died? Why? Wow… I died…
R: How did you die?
S2: I change my item…
S1: Maybe you fall down from the top of the latter.
R: Where you carrying anything? What were you carrying? Maybe okay…

S2: A torch…
S1: Ah, no no. All items I have.
<laughter>
S1: Maybe completed.
S2: Yup.
R: Perfect! Perfect, perfect, perfect.

S1: Yeah…
R: You are complete and finished. Okay, so let me stop… hold on.
S1: Okay.

<end of recording>

APPENDIX H

Task One

Make copies of some shapes

Player 1: Go through the yellow door. You will see a shape. Explain to Player 2 how to build the shape.

Player 2: Stay here (don't go through the yellow door). Build the shape that Player 1 describes to you.

Next, both players have a blue door in their rooms. Go though the blue door in your room. You will switch roles and build a new shape.

Player 2: Explain to Player 1 how to build the new shape that you see.

Player 1: Build the shape that Player 2 explains to you.

Please tell the instructor when you are done with both shapes.

APPENDIX I

Task Two – Player 1

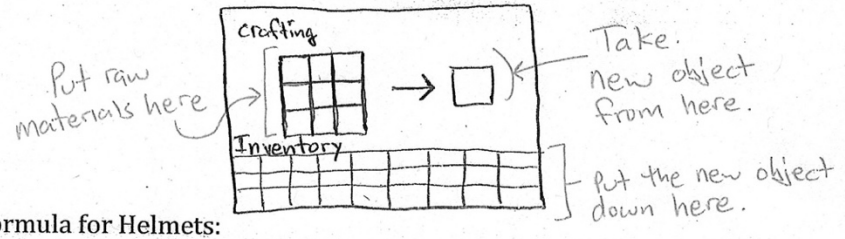
You and your partner will each make some armor using iron ingots. (An iron ingot is basically a small block of iron.) You must both wear a complete set of armor: a helmet, a chestplate, leggings, and boots.

You and your partner know different information about how to complete the task. You must share your information to complete the task successfully.

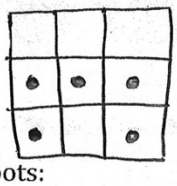
This information might be helpful to you:

How to Craft:

1) Click on the crafting table with the ~~left~~ right mouse button. You will see a menu like this:

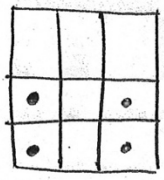


Formula for Helmets:



● = put one iron ingot here.

Formula for boots:

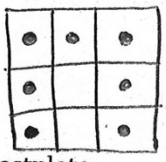


Please tell the instructor when you are done with Task Two.

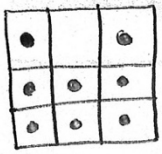
Task Two – Player 2

You and your partner know different information about this task. You will need to share your information to complete the task successfully.

Formula for leggings:

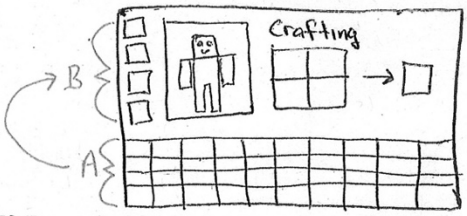


Formula for chestplate:



How to wear armor:

1) Press 'e'. You will see a menu like this:



Move the armor from the 'A' ~~area~~ area to the 'B' area.

2) Press 'esc' (escape) to go back to the game.

Please tell the instructor when you are done with Task Two.

APPENDIX J

Task Three – Player 1

You and your partner know different information about this task. You will need to share your information to complete the task successfully.

This information might be helpful to you:

How to Build a Farm
Use any kind of hoe (such as a diamond hoe) on a dirt or grassy area to turn that area into farmland. You can put seeds on top of the farmland, and they will start growing.

Please tell the instructor when you are done with Task Three.

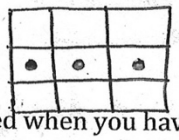
Task Three – Player 2

You and your partner know different information about this task. You will need to share your information to complete the task successfully.

In this task, you must do the following:

1) Plant some wheat in "Area A". (Make Area A into a wheat farm.)
2) After you build the farm, you must each make a loaf of bread.

Formula for bread:



● = One Piece of Wheat

The task is completed when you have planted wheat in Area A, and you and your partner have made a loaf of bread.

Please tell the instructor when you are done with Task Three.